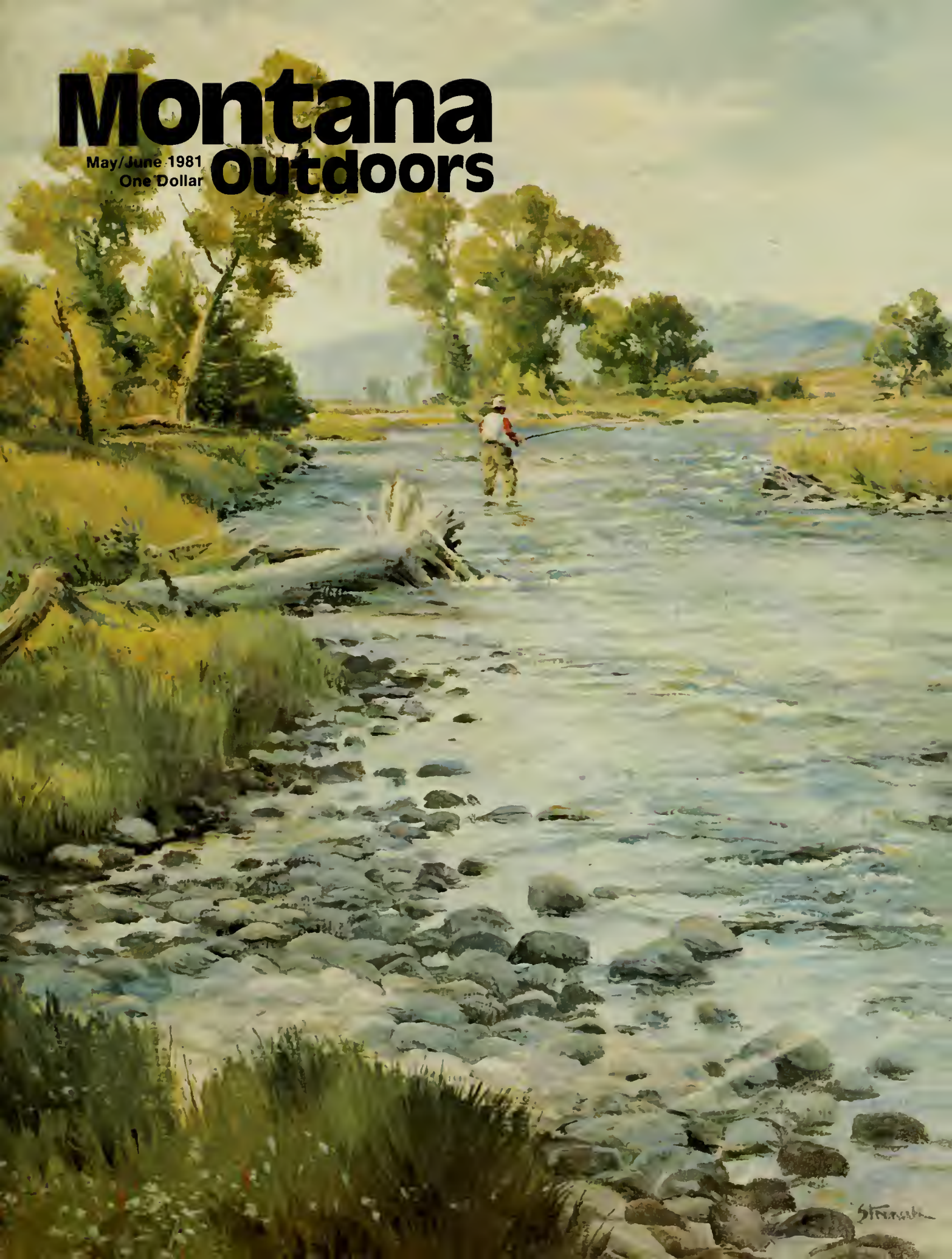
Montana Outdoors

May/June 1981
One Dollar



Montana Outdoors

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THE COVERS: Painted especially for this issue of *Montana Outdoors,* Lee Stroncek's front cover captures the texture, color and spirit of a fine day's fishing on the Gallatin. Robert Spannring's back cover—a combination of pen and ink and watercolor—is both a portrait and a wish: that our children might fish the same river, learn its ancient currents and meanderings, and gain from its healing solitude.

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Montana Outdoors, the official publication of the Montana Department of Fish, Wildlife and Parks, is published bimonthly (January, March, May, July, September and November). Contributions (manuscripts or illustrations) are welcome with the understanding that the department or the editor cannot be responsible for loss or damage. All contributions will be published at the discretion of the editor. Subscription rates are $5 for one year, $9.50 for two years, $13 for three years. (Please add $2 per year for foreign subscriptions.) Individual copies are available at newsstands and regional department offices. Price per copy is $1. Although *Montana Outdoors* is copyrighted, permission to reprint articles is available by writing our office or phoning us at 406/449-2474. All correspondence should be addressed: *Montana Outdoors*, Department of Fish, Wildlife and Parks, 1420 E. Sixth; Helena, MT 59620

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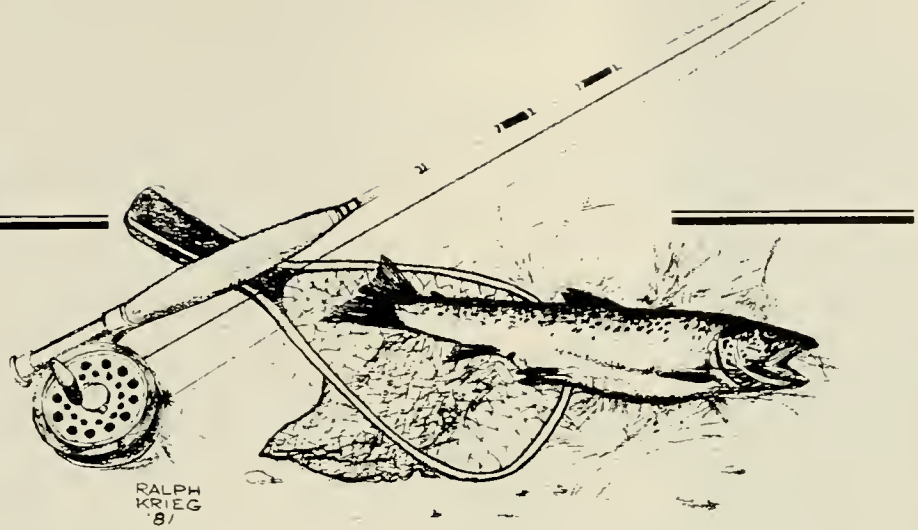
Postmaster: Send address changes to: *Montana Outdoors*, Department of Fish, Wildlife and Parks, 1420 E. Sixth; Helena, MT 59620. Second-class postage paid at Helena, MT 59620 and additional mailing offices.

Overview



Montana's diverse aquatic habitats—more than 9,000 rivers, streams, spring creeks, lakes and reservoirs in all—support 81 species of fish, 16 species of amphibians and hundreds of species of aquatic invertebrates. These waters sustain a recreational fishery worth millions of dollars; provide riparian habitat for a host of bird and mammal species; supply water for agriculture, municipalities and industry; support a limited commercial fishery; generate hydroelectric power, and attract thousands of visitors to the state each year.

The Department of Fish, Wildlife and Parks—charged by law with managing, protecting and propagating fish and other aquatic organisms—plays a major role in safeguarding the quality and integrity of Montana's aquatic ecosystems. Although this role has remained relatively constant over the years, the management emphasis and complexity of the task have changed and grown considerably. While early legislation dealt primarily with species of interest to fishermen, more recent laws have concentrated on the broader aquatic resource and on habitat protection. For example, current programs include maintaining adequate instream flows for fish and wildlife through provisions of the Montana Water Use Act, protecting the integrity of watercourses under provisions of the Stream Protection Act and the Natural Streambed and Land Preservation Act, and conducting basic resource inventories and studies on fishes of "special concern."

One of our goals is to see that no aquatic species—or the ecosystem that sustains it—disappears from Montana's landscape. In keeping with provisions of the state's Nongame and Endangered Species Act, department biologists have identified 14 fishes of "special concern," including such popular game fish as the paddlefish, Yellowstone cutthroat trout and Arctic grayling.

At the same time that we are protecting certain species from diminishment, we are attempting to provide the best sport fishing possible within the limits of our financial resources and the physical capabilities of the habitat. Studies on fish populations and habitat requirements, along with resulting management measures such as habitat preservation, fish planting and fishing regulations, are all helping to achieve this goal. Because we have learned that stocking of most streams is not only unnecessary but potentially harmful to native trout populations, management today emphasizes wild fish populations and the habitat necessary to maintain them. At the same time, however, it is important to remember that roughly one-third of Montana's fishing takes place on lakes and reservoirs where natural reproduction of trout and salmon is limited or nonexistent. That is why the department still operates eight fish hatcheries (one of them is owned and funded by the U.S. Army Corps of Engineers), which produce in the neighborhood of 8 million trout and salmon for planting each year.

In keeping with the goal of providing the maximum recreational use of Montana's waters consistent with sound management, the state's fishing regulations have generally been liberal. However, we have recently implemented some special restrictions on selected waters to increase the opportunity for anglers to catch large trout. These restrictions have come about as a result of long-term studies showing that the average size of fish on such heavily fished rivers as the Gallatin, Madison and Big Hole is decreasing. Some sections of these rivers have over 500 fisherman days per mile, and many of these fishermen, if they keep any at all, tend to select the larger trout. We believe that by requiring fishermen to release trout in the 14- to 21-inch range on some river sections, the number of larger trout can be increased and the quality of the fishery improved.

Another problem facing the department down through the years has been that of providing adequate recreational access to Montana's rivers, lakes and streams. To alleviate the pressure on private landowners, the department has established a system of nearly 200 state-owned fishing access sites, most of which have been acquired and developed during the past 16 years under the stewardship of the Parks Division. With inflation and escalating land values, it will become more and more difficult to expand this system and, in fact, to maintain the sites already acquired.

Management of Montana's aquatic resources is an ever-changing and ever-growing challenge. We hope this issue of *Montana Outdoors* will explain our fishery management programs and policies, and help clarify the department's role in water resources management, an area of vital concern to all of us.

Art Whitney

Administrator,
Fisheries Division

Living Water

THE HUMAN body consists mainly of water. So does a cucumber. So does the surface of the earth. An odorless, tasteless liquid, say the scientific encyclopedias, abundant and widely distributed throughout the planet; built with simple elegance from two hydrogen atoms and an oxygen; essential in plant and animal nutrition; constituent of the crystals of many minerals; blue when encountered in thick layers: water. You can't get away from the stuff, and if you could, you wouldn't want to. It is an exaggeration to say that "Water is life," an exaggeration of the ubiquitousness, and perhaps the importance, certainly the durability, of life. Water came first, necessarily. Without life, there would still be water. Without water, no life.

The first primitive form of life was probably born about three billion years ago, when a bolt of lightning striking the primordial sea water delivered an energy jolt that spurred dissolved amino acids to cluster into self-interested coalitions of protein. The protein clusters began to grow into droplets, to pull water molecules

by David Quammen
graphics by Kris Ellingsen

Blackfoot River photo: Tony C. Caprio

up around themselves like cell walls, to compete with each other for the recruitment of further dissolved molecules—and the process of organic evolution was under way. But by that time it had already been raining on earth, the seas had been rising and falling, the rivers had been flowing, for over a billion years.

Of all the types of hydrological features into which this planet's water has arranged itself—oceans, polar ice, glaciers, groundwater, fresh and salt lakes, soil moisture, atmospheric vapor—the least imposing, judged by volume, are rivers. Only *one millionth* part of our total water, as it turns out, is at this moment moving within the banks of rivers. Don't be fooled: They are important, in the history of life, in the history of man, far beyond their size. Rivers have served as crucibles of evolution, pathways of colonization, sources of power, and inspiration, and topsoil. They not only provide, they deliver. Glaciers come and go, lakes fill up and disappear, but rivers continue to follow their chosen routes with exceptional permanence, changing character gradually, maturing, cutting tight canyons and then wide valleys, shifting about restlessly within their domains, wandering always, always leaving, never gone; offering to their living inhabitants that one crucial element which survival by evolution demands: time. Just recently, say within the last 7,000 years, the great early flowerings of human culture appeared, surely by no accident, in the Nile Valley, along the Indus, between the Tigris and the Euphrates, on the banks of the Hwang Ho. The sea is where we came from. Rivers are how we got here.

Every river on earth is a symphony of elaborate and ordered entanglements—physical factors entangled with chemical factors entangled with biological ones—and as sure as the "Jupiter" symphony is not the "Pastorale," every river is different from all others. But one thing remains common by definition, and represents the central, dominating fact to be coped with by the creatures that make their lives in rivers: The water never stops moving. The pressure of current never relents. The river, as Roderick Haig-Brown has said, never sleeps. To the plants and animals involved, the current brings food, oxygen and all the other nutrients they need for survival; it also, that very same current, threatens every moment to sweep them downstream into drastically different habitats where they will quickly die. The current giveth, the current taketh away, the current has the power of a god. Because of this harsh reality, a river is perhaps the most challenging of ecosystems. It is also one of the most complicated and—thanks to that complexity—one of the most rich.

Current velocity is a variable factor, interdependent with a number of other physical variables, including source of the water, slope of the streambed, depth of the channel, width of the channel and total volume of the water being moved. When one of those factors changes, the others make compensatory adjustments, and the path and shape of a river reflect their compromise. For instance, if the source of a river is snowmelt from high mountainsides, the volume of discharge generally rises to a torrential peak in late spring or early summer, carrying sediments and pushing boulders, back-cutting by erosion to flatten the slope of the streambed, dismantling riffles and rebuilding them, widening and deepening the channel on the outside of the bends, sometimes gouging entirely new channels, short cuts, that may become permanent when the flooding subsides. If the source is a glacier the pulse of high water comes later, in midsummer, and is less extreme, simply because ice melts more slowly than snow. If the source is a spring, there is no annual flood, little erosion, greater permanence to the shape of the channel. And if the source is groundwater seepage, the river is actually lowered in springtime, when riverside trees leaf out and begin competing to suck away moisture. Most rivers, of course, have a combination of sources and a mixture of these flow regimens. The whole system of discharge and channel adjustment tends, as the scientists say, toward conservative dynamic equilibrium. In other words: The water looks for the laziest way of getting itself fastest to the sea.

In times of normal flow, a streambed composed of rocks and large boulders retards current velocity,

"And now for the Water, *the Element that I trade in. The* water *is the eldest daughter of the Creation, the Element upon which the Spirit of God did first move, the Element which God commanded to bring forth living creatures abundantly; and without which those that inhabit the Land, even all creatures that have breath in their nostrils, must suddenly return to putrefaction....*

"...I shall tell you what some have observed, (and I have found it to be a real truth) that the very sitting by the Rivers side is not only the quietest and fittest place for contemplation, *but will invite an Angler to it....*

"And an ingenuous Spaniard *says,* That Rivers and the Inhabitants of the wat[e]ry Element were made for wise men to contemplate, and fools to pass by without consideration."

"The Compleat Angler"
Izaak Walton

holding the water back by friction, while a sandy bottom offers little resistance. A wide and deep channel also entails less friction—which is why broad lower stretches of a river like the Mississippi, despite the gentle slope, despite the sluggish appearance, despite what we expect, may well be flowing faster than many steep mountain rivers. Whatever its size or shape, a river with current velocity of four to six feet per second is moving quite swiftly. At eight feet per second, it is roaring. Very few creatures, even among those adapted to river habitats, can survive against such a constant force. So they have found and invented ways, not to live in the current, but to live out of it. The most important of those little secrets is called the *boundary layer.*

Current speed at any point in a channel is inversely related to depth, with the surface water in midstream moving fastest, other water moving slower beneath the surface and nearer the banks, and the deep water moving slower still; but a point is reached, about one to three millimeters above the streambed, where the water is not moving at all. Brought to a full stop by friction, this boundary layer of still water allows a huge variety of small animals, mainly insects, to live and flourish along stream bottoms in even the stretches of heaviest current. It also explains why most river insects are shaped more like alligators than like giraffes: They are adapted for life in the boundary layer, where it is a mortal necessity to keep your head down.

Also necessary to support life on the stream bottom are a variety of dissolved gases and solids, especially oxygen, carbon dioxide, calcium, potassium, nitrate, phosphate and silica. Unless oxygen is present to the level of four or five parts per million, animals such as stoneflies and trout, with great respiratory needs, will suffocate. Under conditions of high temperature, the same animals may require twice as much oxygen—yet as the water temperature rises above 70°F, oxygen will be forced out of solution and lost from the river. It is stirred back in by any turbulent movement, over riffles, down cascades, and replaced during daylight by the photosynthetic activity of green plants. At night the concentration tends to fall again, with photosynthesis shut down for lack of light, and both animals *and* plants using oxygen for respiration. The decomposition of dead plant tissue, a massive continuing enterprise conducted in rivers by bacteria and fungi, also consumes oxygen. Rivers are constantly depleting their oxygen, and constantly—unless they are dammed—replacing it. A river must tumble, must thrash, must dance along freely, or it goes blue in the face.

Meanwhile the plants breathe in the carbon dioxide that the animals have exhaled. Thick layers of moss spread like green terry cloth over rocks in the shady areas where carbon dioxide is plentiful, and provide habitat for tiny species of insects, crustaceans and fleas. Dissolved carbon dioxide also nourishes algae (which serve as fodder for many insects), and allows calcium to remain in solution as calcium bicarbonate, an important mineral salt. This available calcium salt balances the acidity of the river's water, encourages algal growth, helps fish to breathe more efficiently and provides snails, mussels and crayfish with building material for their shells. It is precious useful stuff, calcium bicarbonate.

Potassium, nitrate and phosphate are all essential plant nutrients, natural fertilizers, and even silica evidently spurs the growth of diatoms, those microscopic algae that coat stream boulders in a smooth slime and turn wading fishermen into riotously comic spectacles. Nitrate and phosphate enter a river mainly through rainfall, runoff from the land surface and bank erosion. Nitrate also arrives, like a sprinkling of compost to help the river plants burgeon, in the dead foliage dropped on the water by streamside trees—particularly a common species of alder, which concentrates in its leaves exceptionally high levels of nitrate, and vastly enriches the food cycle of any river into which those leaves fall.

Fallen leaves, in fact, are the single chief source of fuel for the river ecosystem. The chain of river life begins—in an important sense, the sense of energy transfer and the construction of living matter—in autumn, at just the time when life on land is closing down for the winter hiatus. Yellowed alder leaves, aspen and willow and cottonwood, drift onto the water and float for a while,

"...The face of the water, in time, became a wonderful book—a book that was a dead language to the uneducated passenger, but which told its mind to me without reserve, delivering its most cherished secrets as clearly as if it uttered them with a voice. And it was not a book to be read once and thrown aside, for it had a new story to tell every day. Throughout the long twelve hundred miles there was never a page that was void of interest, never one that you could leave unread without loss, never one that you would want to skip, thinking you could find higher enjoyment in some other thing. There never was so wonderful a book written by man...."

"Life on the Mississippi"
Mark Twain

then sink, to become wedged between rocks; bacteria and fungi climb aboard and begin feasting, digesting, causing decay; the leaves crumble to a fine mulch that sails away on the current. Downstream, the larvae of caddisflies, blackflies and mayflies scoop in the mulch with all manner of ingenious nets and filters, and devour it like a chef's salad, bacteria and fungi included. Where the mixture falls to rest in dead water, where half-decayed fragments catch in crannies, stonefly nymphs waddle up to browse, hungry crayfish appear, and those delicate shrimplike scudders, the amphipods. Eaten once, passed once through a gut, the same stuff is taken again further downstream by other insects and shellfish, passed again through a gut, and still again after that, until all food value has been extracted. It's a system that brooks no waste. This nutritious vegetable bounty is called *detritus:* the granola of rivers.

Other species of mayfly, stonefly and caddisfly, as well as midge larvae and snails, satisfy themselves grazing algae off rocks. The common blackfly larva, bizarre of design and flexible of habit, hangs backward from hooked feet with its head swinging downstream, straining the current with bristly mustaches for detritus and floating diatoms, and then occasionally for variety, bends over to scrape its foothold clear of algae. A few stoneflies and caddisflies also raid the moss gardens. All of these pacific invertebrates—grazing and cropping and savoring their tangy mulch—are the primary consumers in the river ecosystem, the creatures responsible for turning vegetables into meat. After them, in hot pursuit, come their natural enemies, the small carnivores. Most of these, too, are insects.

The dragonfly nymph is a formidable hunter, with a wildly improbable lower lip that springs out under hydraulic pressure, snags a tiny victim in its hooked teeth, and then, on retrieve, slaps the food straight back into the dragonfly's mouth, brisk and indelicate as a chimp stealing peaches. Making it even more deadly, the nymph has a pair of large compound eyes that achieve their binocular focus at precisely the point before its nose where the lip structure reaches full extension: Any morsel seen with both eyes is a morsel perfectly targeted. One type of caddisfly larva builds a conical silken net facing open to the current, then lurks at the narrow end and, when a smaller animal is swept in, rushes out like a spider to pounce on it. Large nymphs from a branch of the stonefly clan—not the branch from which our salmonfly comes, that great gentle lummox, but another—are also estimable predators, as are both the larvae and adults of some water beetles, and even a few species of mayfly. On their best days, these secondary consumers rule as lords of the stream-bottom jungle; one bad day, one mistake, one loss of footing, and they are in the belly of a trout.

Thousands of bad days for millions of cold-water insects, and the result is what we often call, with some narrowness of vision, a good trout stream. But a good trout stream must first be an excellent insect stream, a superior haven for algae and fungi and bacteria, a prime dumping ground for dead leaves, a surpassing reservoir of oxygen and calcium. It will then also, and thereby, be a good osprey stream, a favorite among otters, a salvation to dippers and kingfishers and bank swallows and heron, mergansers and Canada geese and water shrews, mink and muskrat and beaver. Also the occasional grizzly bear. And who knows but that, sometime, a human might want to drink.

The essence of vitality for any ecosystem is complexity and balance. In a free-flowing mountain river, the physical, chemical and biological conditions that constitute habitat for a single living creature change drastically over short distances in all directions—upstream, downstream, shallower, deeper, in front of a rock, behind it, under it. This heterogeneity makes for spectacular diversity of species, comparable to an ocean shelf, or the heart of an equatorial rain forest. And that diversity in its turn makes for great complexity of interlocking relationships, great richness of life, and balance.

But the balance, in a river, is especially precarious, especially delicate: because the water never stops moving. The pressure never relents. The boundary between life and death is measured in millimeters. There is no room for error.■

"Of course, now I am too old to be much of a fisherman, and now of course I usually fish the big waters alone, although some friends think I shouldn't. Like many fly fishermen in western Montana where the summer days are almost Arctic in length, I often do not start fishing until the cool of the evening. Then in the Arctic half-light of the canyon, all existence fades to a being with my soul and memories and the sounds of the Big Blackfoot River and a four-count rhythm and the hope that a fish will rise.

"Eventually, all things merge into one, and a river runs through it."

"A River Runs Through It"
Norman Maclean

(reprinted from "A River Runs Through It" by Norman Maclean, by permission of The University of Chicago Press. © 1976 by The University of Chicago)

FISHERIES MANAGEMENT

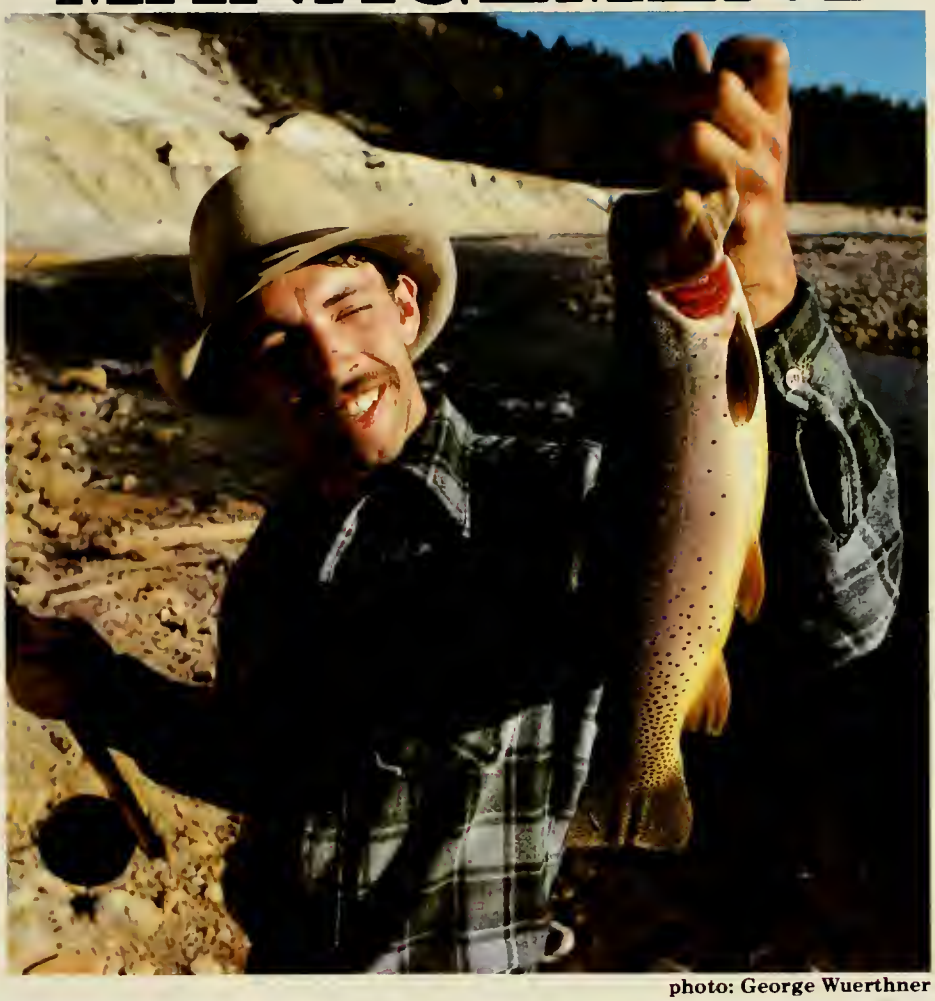


photo: George Wuerthner

Special Regulations for Larger Trout: Is Montana Ready?

by Ron Marcoux

"THE SIZE of fish in this stream has sure gone downhill! I can remember 10 years ago when you would always come home with a four-pounder!"

Comments like this are heard frequently on some of Montana's most famous trout waters. Has the average size of trout in our rivers actually decreased? In some cases, unfortunately, it has; trout populations *have* changed. This is usually a result of habitat changes—such as dewatering, cover removal or sedimentation—rather than a consequence of fishing. But in certain situations, fishing pressure has played an important role.

Long-term electrofishing and creel census studies on the upper Madison River have shown that fishermen can have an impact on the numbers of

larger trout. Although fishing on this stretch of the Madison still rated "good" in terms of numbers caught, creel data showed that high percentages of the older and larger trout were being caught and kept by fishermen, and that the average size of available fish was decreasing. If you give most fishermen a choice, they'll keep the "big ones" and throw back those in the seven- to 10-inch range. This selective harvest can reduce the numbers of big trout on such heavily fished blue ribbon waters as the Gallatin, Madison and Big Hole rivers in southwestern Montana and Rock Creek and the Blackfoot River in western Montana.

What constitutes a large trout in Montana's major rivers? Dolly Varden ranging from 10-15 pounds can be common during the migratory runs of this species in northwestern Montana. But in the rivers where browns, rainbow or brookies are the chief resident species, a trout in the 10- to 15-pound range is rare. In fact, trying to generalize about what constitutes a large trout only gets a person into trouble. A fisherman from the East may consider a 14-inch brook trout a trophy, since he's accustomed to catching them in the six- to 10-inch class, while an experienced Montana fisherman may need a trout over four pounds before he feels he has landed a trophy.

In most of Montana's major trout rivers, a 20-inch trout is the exception rather than the rule. Many trout are found in the eight- to 14-inch range; but above the 18-inch mark, numbers decline rapidly. For example, on one of the more productive mile-long sections of the Madison, sampling showed that 50 of 2,500 trout over six inches were greater than 18 inches. On a mile-long section of the Big Hole, 48 of 965 trout were over 18 inches. With the exception of several rivers where tremendous fish growth occurs immediately below reservoirs, the vast majority of Montana rivers follow this trend.

Let's assume: 1) 500 good fishermen each spend one day fishing on the same mile-long section of river; 2) 50 trout over 18 inches live in the section, and 3) these fishermen choose to keep the larger trout they catch. The conclusion from these assumptions is obvious: It wouldn't take much of a harvest to impact the average size of the population.

The scenario above is all too real. Several sections on Montana's major trout rivers have over 500 fisherman days per mile, and these fishermen, if they keep any at all, generally select the larger trout. This situation creates a dilemma for the fisheries manager. As numbers of experienced and novice fishermen increase, can we continue to satisfy demands for larger trout on our heavily fished rivers?

"...only artificial lure fishing will be allowed in these special larger trout management areas."

The answer is yes—*if* we are willing to accept the need for diversity of angling opportunities. That will mean changing regulations, and consciously managing to produce that diversity of opportunity. During the past two decades, Montana has kept regulations simple, so as not to confuse the fisherman nor complicate enforcement. In recent years, special management areas on the Madison River and Rock Creek have involved more complicated regulations, in an attempt to increase the quality of the fishery.

States like Pennsylvania and New York—where fishing pressure is heavy due to the tremendous population densities—have long had a wide spectrum of angling regulations. Fishing for fun, fly-fishing only, two trout over 15 inches, six trout over nine inches—these are just some of the regulations imposed, many at the whim of local fishing groups. This hodgepodge of special and individualized rules recently led to a moratorium on certain regulations in Pennsylvania. Del Graff, chief of fisheries, said in *Pennsylvania Angler* (June 1977): "It is time now to pause and give serious consideration to exercising a little better control and direction over the whole concept of utilizing special regulations in fisheries management. Critical evaluation is long overdue."

Montana should take heed of these comments. Any new programs should be carefully evaluated to make certain we are accomplishing what we are striving for. Otherwise we may join Pennsylvania in coping with a conglomeration of regulations too hastily imposed—regulations based on feelings rather than on potential contribution toward a real objective.

Management tactics aimed at providing the opportunity to catch (not necessarily keep) larger trout, in the 14- to 21-inch range, have recently been enacted on heavily fished sections of the blue ribbon Gallatin and Big Hole rivers. But rather than leap into this program too fast, the department recommended trial sections about 20 miles long which have the potential to provide larger trout. Public meetings were conducted and both landowners and fishermen overwhelmingly supported the program.

One concern did surface: the question of discrimination against the bait fisherman, since only artificial lure fishing will be allowed in these special larger trout management areas. The lure-only regulation is based on many studies that show that trout hooked deeply with bait have high mortality when the hook is removed and the fish released. Since the special regulations of three trout under 13 inches and one trout over 22 inches will require that those from 14-21 inches be released, the lure-only regulation was proposed. It was not aimed at attacking bait fishermen, but was enacted to provide the greatest opportunity to attain the management objective of having more trout in the 14- to 21-inch range available to the angler.

Will the program be successful? Only time will tell. It is important that we monitor the trout populations as well as fisherman use and success rates. Although such monitoring is expensive, this information will be essential in helping to provide big trout fishing for future anglers.

If Montana is to remain a leader in providing opportunities to fish for wild trout, new programs need to be evaluated to better understand the various potentials of our fisheries. The other option is to stand back watching the average fish grow smaller, and reminisce about the good old days when you could catch an 18-inch trout.■

Lake Population Census: Sounding Out Secrets

by Laney Hanzel

FISH STOCK analysis is a management strategy geared toward combining knowledge about the number of fish available for harvest with the annual increases and mortalities occurring in the population. By providing a method to gather information about all size classes of fish, nets play an important role in making such assessments in lake populations. Nets must be able to catch the large, harvestable fish as well as small, juvenile fish.

It is important to understand how fish react to other kinds of fish living in the same water. Often this requires the study of a fish species that we do not plan to angle for or eat. The study of several kinds of fish requires more than one type of fishing gear and various collection techniques. An example of this would be setting some nets on the bottom of a lake to catch bottom-feeding fish while setting other nets near the surface to catch fish feeding on insects found there. The study of several kinds of fish is expensive—but necessary—to understand the interrelationships between species.

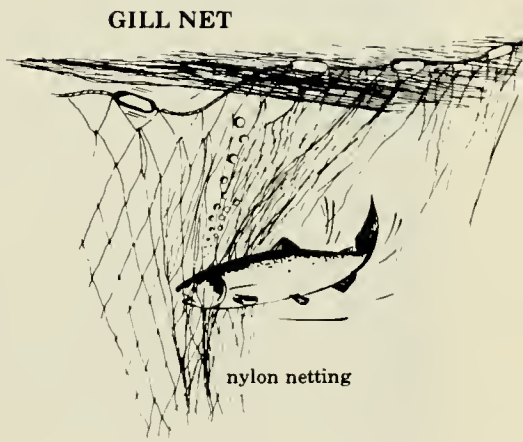
Four basic types of nets are used for lake population studies in Montana:

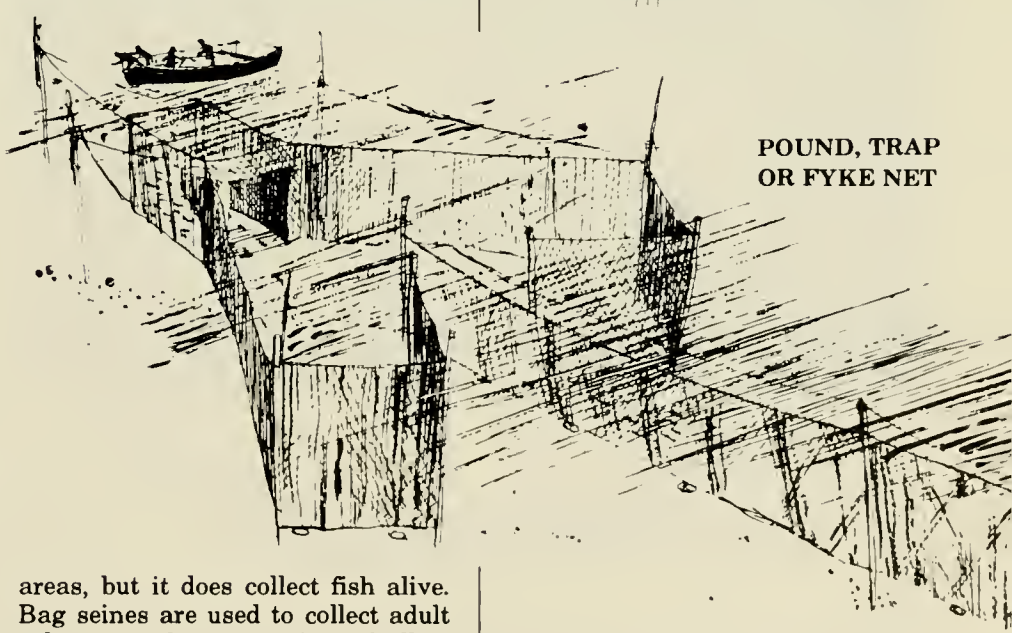
1) *Gill net.* This net is a curtain of fine netting suspended in the water and placed either near the surface or near the lake bottom (depending on the type of fish being studied). Fish are caught when they swim into the net and become entangled in the mesh, usually by their gills. By varying the size of the mesh openings, researchers can select the size of fish to be caught. These nets are generally set overnight during an active period of fish movement. Fish collected in this type of net are usually injured or dead, and are used for age analysis, food habitat studies, growth data, etc. This method's simplicity makes it an important study tool.

2) *Pound net.* A trap, fyke or pound net (all similar in design) is often used to collect live fish. These nets use a fence of netting to lead fish into a trap area where they can be captured easily. The nets are successful when sampling for bass and pike, when placed in areas where fish are moving near shore or in shallow water. Live fish are tagged for population studies, migration studies and other sorts of behavioral research.

3) *Bag seine.* A bag or beach seine can be used to collect fish if they concentrate while feeding or are migrating onto beach areas. A length of netting is drawn by man or boat, completely encircling the fish. Then the net is pulled in, shrinking the size of the circle until the fish can be readily caught. Again, this sort of net is only effective in shallow beach areas, but it does collect fish alive. Bag seines are used to collect adult salmon as they move into shallow shoreline areas to spawn.

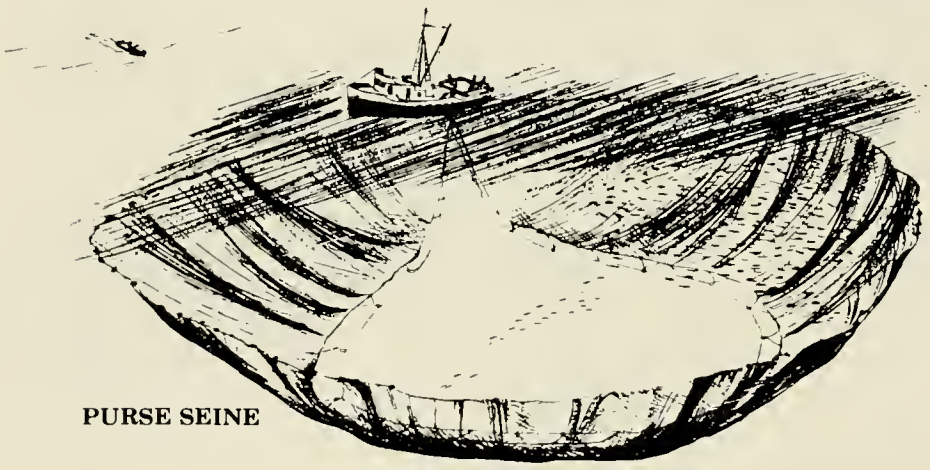
4) *Purse seine.* A purse seine can be used to collect fish in deep, open areas of a lake. This net is operated much the same as the bag seine. First the netting is drawn around a fish concentration, then a line fixed to the





BAG OR BEACH SEINE

The 32-foot research vessel, the "Dolly Varden," is equipped with sophisticated echo sounding equipment. The vessel has been engaged in fisheries research on Flathead Lake since 1966 (DFWP photo: Dave Wedum).



PURSE SEINE

bottom edge of the net is pulled (or pursed), causing the bottom of the net to close, and thus capturing the fish in a bag. Because this net only fishes to a depth of one-half its straight depth measure, massive amounts of netting are needed, which in turn require a large, powerful boat. Purse seines are utilized to collect salmon and trout that are found schooling in open water of large lakes and reservoirs.

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Any fisherman recognizes that he or she must have a good idea where the fish lie before attempting even the first cast. The same sort of information is also required by fisheries scientists prior to using nets. In the late 1950s, a device was developed which provides this information. The electronic "echo sounder" locates fish and gives an indication of their numbers. The sounder was a spin-off from sonar developed during World War II, at the height of submarine warfare, for detecting underwater objects.

Like the sonar, the echo sounder uses sound waves and their reflected echoes for underwater detection of objects. The sole difference between sonar and the sounder is in the way sound leaves the instrument. Sonar sends sound waves in all directions, making a circular pattern, whereas an echo sounder sends the sound in a confined, narrow beam, usually from the surface to a particular area of the bottom. Refinements of the sounder now allow recognition of small fish (one to two inches in length) at depths greater than 100 feet. Sounders can display their targets as light blips from a neon bulb or as marks on a printed chart. These charts (echograms) readily indicate fish distribution patterns by area, depth and numbers.

Use of the sounder, coupled with the use of nets to verify types of fish, enables fisheries personnel to acquire more information on lake populations in Montana. This data can be collected faster and in greater detail than was previously possible. And the information gathered will provide the basis for managing fish populations in the 1,900 lakes, ponds and reservoirs of Montana that annually provide nearly 1.7 million days of recreational fishing and many excellent meals.■

Electrofishing: Using Current to Count

by Dick Vincent

AT ONE TIME or another, you may have seen fisheries personnel "shocking" fish in some stream. You were probably curious as to what they were doing, and perhaps you wondered why and how shocking fish helps you as an angler have better fishing. Shocking, or electrofishing, is in fact the most effective means we have to sample and study stream fisheries.

Fish shocking can be done with either alternating or direct current, but direct current is most often used. The electric current, provided by a portable generator, is placed into the water by means of two electrodes—a negative plate, which is fixed, and a mobile positive probe. With direct current (of 250 to 400 volts), trout and most other fish species are attracted to the positive electrode, temporarily stunned and then captured with a dip net and placed in a holding tank. Only those fish within two to six feet of the positive electrode are attracted, which means that many escape capture by avoiding the electric current.

Using electricity to sample fish in streams is not a new idea—the system was patented in the United States as early as 1917—but serious use did not occur until the late 1940s. In Montana, early electrofishing was confined to small streams where existing techniques and equipment would allow adequate capture of fish. The captured fish were weighed and measured, and the population estimate for that stream section was simply the number actually captured and counted. The major problem with this technique was that it was impossible to determine how many fish were missed during the count.

Finally, in the mid-1960s, more advanced techniques were developed, so that larger streams and rivers could be adequately sampled. The power and sophistication of portable electrical sources were increased, allowing effective shocking on larger bodies of water. The use of drift boats or jet-powered craft enabled fisheries biologists to shock deeper water and cover more area of stream.

But the problem remained of determining how many fish are missed, or how to estimate total fish population based on a shocked sample that was always just partial. In small streams, 70%-90% of the fish population may be captured during a single shocking pass. But in large rivers, any one trip down the shocking section may yield only 5%-10% of the total. Many factors influence the overall degree of effectiveness, such as: 1) size of the stream; 2) type of stream, and 3) experience of the shocking crew. Even on a single section, there are daily variations in electrofishing effectiveness, based on weather, water temperature, fish behavior and water turbidity.

To compensate for all these variables, a method was devised for deter-

Fish shocking, shown here on the Big Hole, provides estimates on how many fish inhabit a section of river, their size, age and species (DFWP photo: Mike Gurnett).

mining the *percent* of the total population actually captured in a single shocking pass, and then using this percentage, plus the actual count of captured fish, to reach a reliable estimate of the number of fish in a given section of river. The method works like this:

A section of stream, two to five miles in length, is selected. A single electrofishing trip is made through the section, with periodic stops to weigh, measure, mark (with fin clip or tag) and release captured fish. The same procedure is repeated one or two more times through the same section, to mark as many total fish as possible. Then there is a 10- to 14-day wait. Afterward, two or three more shocking trips are made down the section, to obtain another large sample of fish. These later passes are called *recapture trips*. They reveal what percentage of previously marked fish are being recaptured, and on this basis an actual population estimate is made. For example, if 1,000 fish were marked during the initial trips, and an initial 1,000 were taken during the recapture trips—of which 100 had been previously marked—we could deduce that we had marked 10% of the total fish during the initial trips. And the estimated fish population would therefore be 10,000. Thus, to arrive at a single reliable estimate of population, five or six shocking trips are necessary, over a two-week period, using specialized gear and a trained shocking crew.

Fish population estimates are an essential part of most studies being carried out on the Beaverhead, Big Hole, Clark Fork, Gallatin and Madison rivers. Population estimates are usually made either during the spring (March to May), or in September, or both. These estimates show us not only how many fish there are in a section, but how many of each size, age and species. Information is also gained regarding spawning or recruitment success, growth rates and how much mortality has occurred during the preceding summer or winter. To obtain usable data for management purposes, fish population estimates must be done regularly over a long period on each river in question. Useful information is seldom obtained from short-term studies or single population estimates.

On the Madison River, a long-term sequence of trout population estimates has made possible significant improvements in the wild trout populations, and thereby in angler success. On the Beaverhead River, it took 13 years of trout population estimates to determine the levels of flow that are necessary to maintain a quality wild trout fishery. Utilization of this data has resulted in a significant increase in numbers of wild trout. On the East Gallatin River, continuous monitoring of the effects of sewage effluent from Bozeman on wild trout populations has led to improvements in treatment facilities, with corresponding increases in numbers of wild trout. And on the Clark Fork River near Deer Lodge, fish population estimates were used to monitor the trout fishery, evaluating improvements in the effluent treatment procedures at the Butte mines and the Anaconda smelter; the river has shown significant improvements during the last 10 to 15 years.

Electrofishing is also being used to chart spawning movements of trout, walleye and paddlefish, for possible designation of critical spawning areas. Across Montana, fish shocking serves as an indispensable research tool in all types of situations.■

The Role of the Hatchery: Then and Now

by George D. Holton

DURING RECENT years there has been a change of emphasis in Montana's fish hatchery program, and some people assume that we are planting fewer fish. Not so. In 1980, 7.4 million fish were planted from our seven state hatcheries—as many as ever—and another 677,000 were planted from the Murray Springs Hatchery which we operate for the U.S. Army Corps of Engineers. But there are important differences in the *size* of the fish now being planted, and in *where* those planters are being put. Throughout the two decades prior to 1974 the department did considerable planting of catchable-sized trout, for "put-and-take" fishing. Since 1974, the main share of our hatchery output has consisted of smaller fish that have gone into lakes and reservoirs which offer adequate conditions for fish growth but inadequate conditions for natural reproduction—and where, therefore, little or no sport fishing opportunity would exist were it not for planting.

Planting, of trout in particular, had a favorable beginning in Montana in the late 1800s. Thanks largely to the comparative recentness of the Glacial period (a remnant of a continental ice sheet was still in Montana 12,000 years ago, a short time in geological terms), Montana waters were poor in number of fish species, and many lakes and stretches of streams above barriers to fish passage were fishless. Tiny fish planted in these virgin waters at the turn of the century did exceptionally well. It was then thought that fertilization of fish eggs in nature was haphazard, and therefore that the productivity of a water—any water—should automatically be increased by planting fish hatched in a hatchery. This assumption later proved incorrect.

Researchers eventually found that an average of 90% of the salmonid eggs spawned in the wild were successfully fertilized and deposited in redds (nests). This high rate, coupled with the large number of eggs laid by an individual fish, creates a surplus of tiny fish, most of which die during their first year because there simply isn't habitat for them all. Put another way, once a niche is filled with a reproducing population, planting tiny fish is ineffective. It is as unnecessary as carrying coals to Newcastle and this is what the early fish culturists encountered.

When the planting of small fish was seen to be ineffective, larger and

larger fish were tried, in an effort to make waters provide more fish for the creel. And thus evolved the put-and-take concept: Trout large enough to be caught and kept (about eight inches long) were planted for immediate harvest. But this strategy in its turn, as we now know, has its problems.

It would seem that the logical place to plant "catchables" would be in cold, rather sterile waters with poor productivity; but the harsh conditions resulting in poor productivity also result in poor survival of catchables. They become emaciated, and only a small percentage live longer than three months. Well then, if catchable-sized planters don't prosper in nonproductive waters, what about in streams with good temperature, good cover, adequate food? But now arises another question of basic management logic: If a stream has these attributes, *and* a self-sustaining population of wild fish, why does it need planting?

Answer: It doesn't. In fact, our research has shown that planting the Madison River actually cut the wild trout population about in half, due to crowding and stress, and that the average size of the remaining wild trout was also reduced. Only about 20% of the hatchery fish were caught, and few of them survived longer than 90 days. The overall result was fewer fish in the creel.

Another consideration is cost. To raise and plant a single eight-inch trout costs (including all capital and operational expenses) about 50 cents. Probably only half those fish, planted in various Montana waters, survive to the creel. With legal limits of five or 10 fish per day, a $5 or $6 license fee doesn't go far to support a fishery based on this approach—especially since fisheries management also includes fishing access acquisition and maintenance, enforcement, administration and other management measures such as habitat preservation.

So, although we still do some put-and-take planting, this is only in special areas where there is a shortage of fishing opportunities where nothing else will work, and where heavy fishing pressure ensures that at least 40% of the planted fish will be caught. Rainbow trout are used exclusively as they are the easiest to raise and are readily caught by fishermen.

The heart of Montana's fish planting program today is the annual planting of trout and kokanee (salmon) in hundreds of reservoirs and lakes (including high mountain lakes) which lack tributary streams or other suitable spawning areas. This is sometimes referred to as "put-grow-and-take" planting.

Ideally, before we adopt a strategy of annual planting, we will have determined that a naturally reproducing sport fish population cannot be established through a single introduction or a few years of planting. Care must be taken, of course, not to introduce species that will cause ecological problems.

This photo, taken by a department photographer in the 1920s, depicts early-day fish planting.

Once it is determined that annual planting is the best management plan, a compromise must be struck between planting fish small enough to keep down rearing costs but large enough to ensure adequate survival from predation.

Northern pike and walleye, which are "cool water" fish (trout and salmon are "cold water" fish), are also used in the put-grow-and-take program as fry (newly hatched fish) or small fingerlings. These, and "warm-water" species such as largemouth and smallmouth bass, are not as adaptable as trout to artificial culturing. We depend on assistance from

the U.S. Fish and Wildlife Service in obtaining these species, because hatcheries operated by the state raise only trout and salmon. We also supplement our trout planting each year with fish from the service's hatcheries in Montana.

Our hatcheries have played an important role in the re-establishment of westslope cutthroat trout in waters of their original range, in the management of lakes for Yellowstone cutthroat and in the introduction of Arctic grayling into new lakes. The westslope cutthroat, the Yellowstone cutthroat and the grayling are all "fishes of special concern," so designated because their historical ranges within the state have shrunken precariously. We have brood stocks of the two cutthroats, and we manage one lake as a brood lake for grayling. Fish culture is thus supplementing habitat protection in perpetuating these native fishes.

We have a good hatchery system, the backbone of which is our staff of dedicated hatcherymen. We have enough hatcheries, in terms of capacity, but most of our buildings and ponds date back to the 1920s (some even earlier), and must be renovated.

Hatcheries cannot support all the fishing in the state. We must preserve the habitat of wild trout and other sport species and, where possible, manage fisheries on the basis of natural reproduction. Still, it should be remembered that one-third of Montana's fishing is on waters that are planted.

Fish culture is making a crucial contribution to the fisheries resource.■

Underwater Census: The Waterproof Biologist

by Patrick Graham

Counting fish underwater has proved effective in clean and relatively unproductive streams, like those found in northwestern Montana and northern Idaho (photo: Pat Graham).

I EDGED up to the stream below a deep pool. The sun's rays left patches of light on the water, which was further broken by the giant cedars along the bank. I had thought it would be warmer than this in July. I tugged on my wet suit, cleaned my mask, cleared my snorkel and looked up through the trees. This is all the sun I will get today.

The water was just over 50°F and as clear as glass. I slipped into the riffle and stiffened a bit as the water forced its way into my suit. Once settled, I began to look around.

Ahead in the pool, I could see a few cutthroat trout. They were swimming along the edge of a submerged log at the head of the pool. They would dart out from quieter water into the current and grab passing particles. Some of the particles were consumed, and the less edible were spit back into the current. Closer to me at the tail of the pool, younger cutthroat were positioned near large rocks. The cutthroat too darted after particles, which passed less frequently here.

Almost beneath me, the head of a small bull trout emerged from under a flat rock. It appeared as if the young bull had been burrowing in a cave. Another juvenile bull trout lay on the gravel bottom on the shallow side of the pool. In the shallowest water along the fringe of the pool were fry, apparently also of the bull trout species. They were too big to be this year's cutthroat. Their heads were somewhat flattened and the patterns on their backs resembled the dark, mottled patterns of adult bull trout.

I could estimate the size of most of the fish, but I was not sure about one. It was a large cutthroat near the head of the pool. Rather than take a chance of being deceived by the magnification of images underwater, I pulled closer. The trout swam back under the log, but emerged again after a few minutes. It maintained its position as I held a thin stick nearby. From that, I determined its length.

I crawled across the riffle, dragging myself over the rocks and stretching my neck to keep one eye underwater. A cutthroat trout was in a pocket of water behind a large rock in midstream. If I stayed to this side, it would probably hold or retreat

downstream. I could avoid the possibility of counting it twice.

* * * * *

Two hours later, I rose up out of the water and climbed to a dry spot. The stream broke into a long series of steps as it wound through the ferns and cedar along the bank. I unzipped my jacket and laid back against a rock.

So this is what they mean by an underwater fish census. When I first heard that I was going to do it, I thought, "Is this as far as we have come?" I can still hear the boss:

"Graham, you are going to count fish underwater. You will see life from a side you have never envisioned." He added: "Let me tell you something. Do you know what really takes intestinal fortitude?"

"No sir."

"Jumping into that cold wet suit at 9 o'clock every morning, son. It will take more guts than anything you will ever do." He laughed.

Somewhat amused, I looked at him. "Yes sir." I didn't believe him then. I believe him now.

* * * * *

We had to find out what areas within a stream channel are most important to the fish. No longer could it be assumed that a fish's needs would be met as long as the stream bottom was wet. Demands for water, development and disruptions in the lands from which the water drains change a stream, sometimes imperceptibly. Roads, logging, gas pipelines, grazing, water diversions, sewage and low-head dams all leave their marks.

How much can a stream take? How much can the fish take? How much silt can accumulate in the pools before the fish leave? How much silt can accumulate in the riffles before the insects and fish eggs are displaced or suffocate? Where do the fish go when the stream flow is reduced? Do large and small fish react the same way? We were looking for answers to these questions and others.

We used box traps to assess timing and direction of fish movements during the summer. Fish caught in traps were aged and their growth rates were determined. Using that information, underwater fish counts for size groups within each species could be made meaningful. Fish could be counted more quickly and with fewer people than by conventional electrofishing methods. Although these fish could not be marked for recapture or to determine movement patterns, relative estimates of the number of fish in various habitat types could now be made.

This technique—counting fish underwater—has proved effective in clear and relatively unproductive streams, like those found in northwestern Montana and northern Idaho. It is best suited to small streams and medium-sized rivers; it is not so useful in large rivers or lakes, because the trout do not hold their positions and are usually more dispersed.

After lunch I got back in the stream and continued to tally fish: three young-of-the-year cutthroat, two yearling bull trout and, whoa, an adult bull trout was lying up under the log. Tensed and wary, it opened its mouth slowly. There was the telltale sign of the large hooked lower jaw. A mature male, he looked at least three feet long. He had come up from the river, but with at least two months to spare before he would spawn.

I finished my counting and crawled onto the bank. I rested a minute, and then remembered the hot springs. I walked back to my car and shed the wet suit, both in record time. Tomorrow morning and that wet, cold suit seemed very far away.■

The Saga of Old #134

by Jerry Wells
painting by Lee Stroncek

THE OLD BOY wasn't always known as #134. Prior to an Indian summer day in September 1970, he was anonymous. Just another 2-year-old brown trout, hardly a unique figure in the Big Hole River. He lived in the Red Tail Hole in those days, just up the river from the McCullough Ranch, south of Melrose. Matter of fact, I think he still lives there—but I'm getting a little ahead of things.

It was the first autumn that this brown trout would spawn, the first chance to pass on that genetic information passed down to him from his ancestors. Ancestors that stretched all the way back to Europe, home of his species. It was also the last day he would remain anonymous. On that warm September afternoon, an electrofishing crew from the Montana Department of Fish and Game worked its way down from Melrose to Brown's Bridge. They captured this brown trout and put him in a tank with others of his kind. The fish were measured, weighed, a small edge of a fin clipped, a few scales taken from beneath the dorsal fin; and then they were released. The information collected would be used to assess growth rates and population size. The fish were also tagged with individually numbered blue plastic tags, inserted just behind the dorsal fin, which would be useful later in assessing fisherman harvest and fish movement. Our friend was 13.5 inches long and weighed 1.04 pounds. His blue tag number was 134.

That was the fall of 1970. Many events cast their shadows across the Big Hole and its trout population before we saw #134 again. Reichle Dam was proposed by the Bureau of Reclamation, and again more recently by the Army Corps of Engineers: a dam that threatened to impound a good portion of the blue ribbon section of the Big Hole, and forever change the character of this wild, free-flowing river. (The dubious economic value of this project moved it onto a back burner in the early 1970s, but the proposal is far from dead.) In 1973, snowpack in the Big Hole drainage was very low and the river went to a stage of extremely low water during the summer irrigation season; in August, near the mouth of the river, flow actually ceased. Upstream near Melrose, low flow and high water temperatures resulted in low oxygen concentrations and very adverse conditions for trout. Whitefish were observed dying throughout the river. In 1977, snowpack was again low. Spring rains prevented catastrophic dewatering of the lower river, but the fish population experienced the lowest flow since 1973. These were hard times for trout. And then, on a rainy September morning in 1977, during our first electrofishing run of the fall, we captured #134.

Again he was in the Red Tail Hole, not far from where he had been released seven years earlier. He was now 9 years old, ancient in a species where 5 or 6 denotes a graybeard. He was 18.7 inches long and weighed 2.34 pounds, a beautiful male brown trout with lower jaw (kipe) grown out in preparation for spawning. For nine years he had endured all that the Big Hole had to offer. He had survived low summer flows, winter ice and untold numbers of fishermen. We released #134, awed by his longevity and certain we would never see him again.

A year later, on another Indian summer day in early October of 1978, we made our last electrofishing run of the season on the Big Hole. Flow during that summer had been excellent and the trout had thrived—including #134, whom, to our complete amazement, we captured again. The year had been good to him and he had gained nearly half a pound. He was now 10 years old and 18.9 inches long, weighing 2.88 pounds. He bore a hooking scar on his left upper jaw. Perhaps he had been caught and released by a fisherman during the salmonfly hatch of the preceding June. By now the old boy was pretty special to us and it was with a sense of respect that we gingerly released him

once again into the Red Tail Hole.

The winter of 1978-79 was the coldest on record in the Big Hole country. Temperatures plummeted to 50 below zero and stayed well below zero for weeks at a time. Icing conditions on the river were severe. Spring came late. It was a snowy morning in early April of 1979 when we began our spring electrofishing. To make a long, cold story short, we captured him again.

He had made it through another winter, a tough winter, and he was 11 years old, an unbelievable age for a brown trout. But the winter had been hard on him, and he had lost weight: now 19 inches long, he was down to 2.44 pounds. Eleven years in the Big Hole and our friend had taken all that the river had given him. He had thrived and he had suffered. He had spawned for nine seasons and he had seen three fisheries biologists come and go. For 11 springs, red-tailed hawks had returned to nest and fledge their young in the cliffs above his hole, and still he endured; and so has the free-flowing Big Hole.

Well, we didn't capture old #134 in the fall of 1979, nor did we get him in the spring or fall of 1980. We looked for him and we wondered about him. Did a fisherman catch him, or did he up and die on us? I don't know the answer. But the ice is going off the river and on St. Patrick's Day we are going to start electrofishing, and that night we will stop at Joe Grogan's Bar in Glen—and I hope we can tell Joe that old #134 is still around. He'd be 13 now.■

About The Artists

This issue features the first appearance in *Montana Outdoors* of several artists, among them **Lee Stroncek** of Bozeman. In addition to his generous contribution of a front cover prepared especially for this water-oriented issue of *MO,* Stroncek also painted a brown trout which could well be the "Old #134" described in the article on page 16. After studying wildlife and fisheries biology at the University of Montana and the University of Alaska, Stroncek studied art for two years at Colorado State University. His fascination with wildlife, particularly aquatic wildlife, has led him to most frequently portray the special world of the angler and the fish. He recently was voted into the Society of Animal Artists and his work has appeared in many outdoor publications and hangs in several private collections throughout the country. He works from his home/studio at 909 W. Dickerson, Bozeman, MT 59715.

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Robert Spannring has painted a back cover that is both a portrait and a wish: that the two young fishermen, and their children, and their childrens' children, might continue to share the magnificence of Montana's water. It serves as a fitting conclusion to an issue based on Montana's water resources and fisheries. Spannring's attention to detail reveals his interest in some other activities—photography, backpacking, fishing and hunting. Formerly a wrangler at the Ox Yoke Guest Ranch and a some-time carpenter, Spannring now lives in Livingston and works as a full-time artist. For additional information about his work, contact him at Spannring Studio, P.O. Box 403; Livingston, MT 59047. He plans to continue his art studies at Montana State University in Bozeman this fall.

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Another newcomer to *MO* is **Kris Ellingsen.** She lives in Butte and works as a graphic artist for the National Center for Appropriate Technology. Her pen and inks underscore the elements of "Living Water" (page 2). She says: "I've intended that they reflect some of the excitement I feel about structures, whether living or not; in fact, I view the drawings themselves as structures, so that the cross-hatch technique is really more like line-weaving."

* * * * *

Harvey Eckert's illustrations have appeared in these pages many times and also in national publications, including *Fly-Fisherman, Fishing World, Fly-Tyer,* "United Fly-Tyer's Almanac" and in other books and magazines. Formerly employed at Fran Johnson's Sports Shop in Butte, Eckert is now devoting all of his time to his art. He operates Nature's Shadow Studio at 2800 Gladstone; Butte, MT 59701. His knowledge of piscine creatures and their cohorts can be seen on pages 15 (cutthroat trout), 44 (caddisfly nymph) and 45 (stonefly nymph).

* * * * *

Glenn West's watercolors are an integral part of the "Identification of Montana's Most Common Game and Sport Fishes" (page 19). His painstaking, exacting efforts can be seen in the delicate shadings of color, in the precise location of anatomical markings and in the multitude of other small details that differentiate one fish species from another. West has an opportunity to view his subjects first-hand since he spends summers as an outfitter/guide on some of Montana's blue ribbon trout streams. He has owned a fly-tying shop in Missoula and is an avid fly-fisherman and fly-tyer. He is presently back at school, majoring in art education at MSU.

* * * * *

If a painting could ever "list" most of the things you would need to break one of Montana's fish records, **Charles Fritz's** illustration on page 29 is that piece of art. A small lake and surrounding woods on the outskirts of Mason City, Iowa, provided him with a classroom in which to learn about hunting, trapping, fishing and Indian lore. His understanding and appreciation for nature have grown and matured, which his compositions reflect. The winner of many painting honors and the holder of several major commissions, Fritz has also had three one-man shows; he has two additional shows scheduled for 1982 and annually exhibits at the National Wildlife Art Show in Kansas City, Mo. Of his work, he says: "If my reproductions of God's work can impart a sense of urgency in the appreciation and protection of these fragile resources which man has been given dominion over, then the time has been well spent." He operates Charles Fritz Sporting and Fine Art, P.O. Box 780, R.R. 9; Billings, MT 59101. We're glad to welcome his talents to *MO.*

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Ralph Krieg's work with pencil reveals one of his favorite pastimes: fishing. His contributions to this issue include the illustrations with "Overview" (page 1), which contains the message from Fisheries Division Administrator Art Whitney, and on page 33, to accompany the article "Spring Creeks: Montana's Fragile Fishery." The latter drawing depicts a fisherman plying his art and skill on what many believe is the ultimate test of an angler's mettle. Krieg recently retired from a bureau chief's position in the Montana Department of Revenue. In addition to fishing, he enjoys tying—and occasionally designing—his own flies, hunting and preparing edible wild plants.

* * * * *

Another newcomer artist to *MO* is **Kurt Hill** of Helena. A dabbler in drawing, Hill does fisheries field work for the department's Ecological Services Division. He works closely with Ken Knudson, the department's pollution control biologist, so it is appropriate that his illustration accompanies Knudson's article. Turn to Hill's pen and ink on page 41; it depicts some of the "Needs in the Life of a Fish."■

NATIONAL FISHING WEEK MAY 11-17
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Identification of Montana's Most Common Game and Sport Fishes

compiled by George D. Holton
paintings by Glenn West

The following is a guide to help you identify the most common Montana game and sport fishes. Families are arranged in a natural sequence, from primitive to most specialized. Within families, look-alike fishes are grouped together to make comparisons easier. Also, where practical, the most widespread fishes are listed first.

The information on the characteristics and habitat of each species is a combination of gleanings from many publications, plus numerous suggestions from field biologists of the Department of Fish, Wildlife and Parks and other agencies.

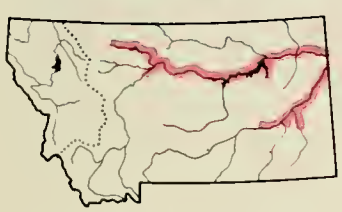
Designation of each species as native or introduced is largely based on information from C.J.D. Brown's "Fishes of Montana" (Big Sky Books, Montana State University; Bozeman, MT 59717, 1971). The range maps were prepared using maps in "Fishes of Montana" as a starting point; these were updated with information from field personnel. Distribution of a species is indicated in color (magenta). When large areas are indicated, there may be population gaps and sparse populations within them resulting from lack of suitable streams and lakes, or from the fact the species has not reached local areas through natural migration or introduction by man. (Due to the potential damage from ill-advised planting, planting of fish or fish eggs in waters of the state is unlawful unless authorized by the DFWP.)

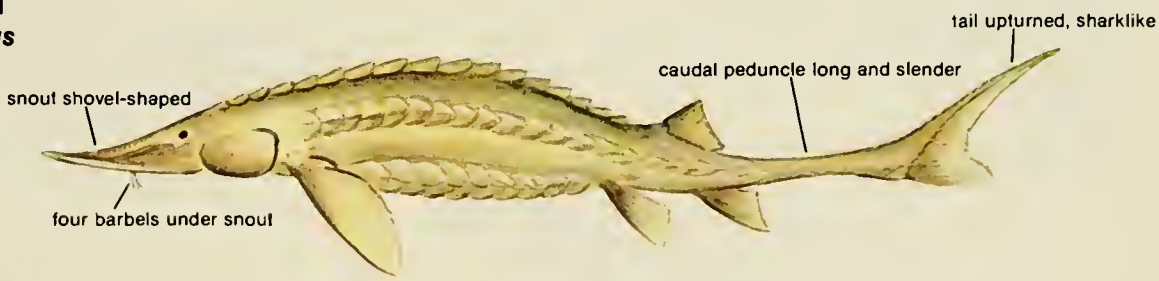
Two lengths are given, for example: 12" (24"). The first number, 12", is a *typical* size. The 24" in parentheses is the usual Montana *maximum* for the species (measured from the tip of the snout to the end of the tail); this length is not necessarily the record, but a length seldom exceeded.

The common and scientific names are those recommended by the American Fisheries Society. "Other Names" are local names. They are listed so the reader can associate the recommended common name with one that may be more familiar.

These pictures, maps and identification clues are a condensation of the game and sport fishes portion of a forthcoming "Field Guide to Montana Fishes" to be published by the Department of Fish, Wildlife and Parks. Scheduled for publication in about one year, the guide will cover all of the fishes in the state.■

SHOVELNOSE STURGEON
Scaphirhynchus platorynchus

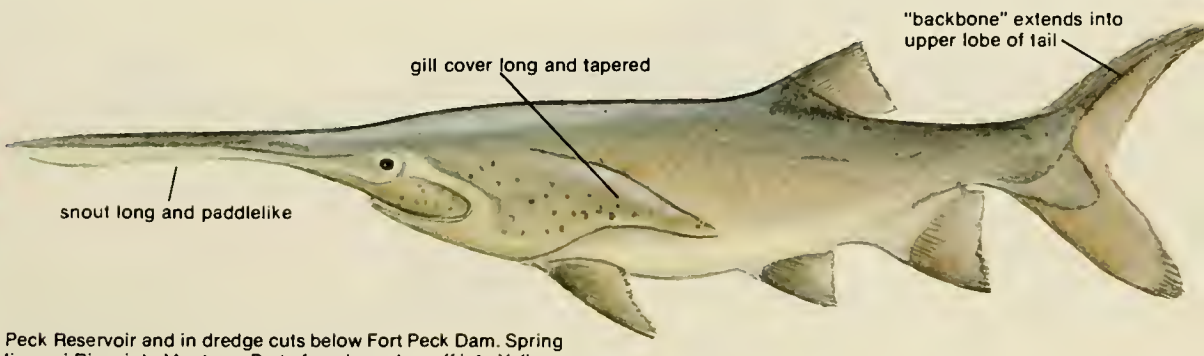




Native. **OTHER NAME:** Hackleback. **HABITAT:** Large rivers and reservoirs. Tolerates high turbidity. **OTHER CHARACTERISTIC:** Maximum weight for Montana is 15-¼ pounds. **SIMILAR SPECIES:** (1) Pallid Sturgeon (not shown), a larger species in Missouri and Yellowstone rivers drainages (reaches 5 feet or longer), is so rare that sturgeon over 16 pounds can be assumed to be Pallid; those under 16 pounds, Shovelnose. (2) White Sturgeon (not shown) has a shorter, thicker caudal peduncle. It is the only sturgeon in Kootenai River (northwestern Montana) where it is rare.

32" (41")

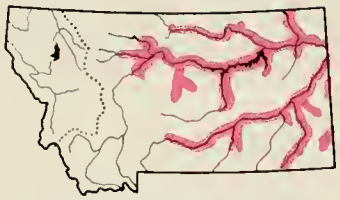
PADDLEFISH
Polyodon spathula



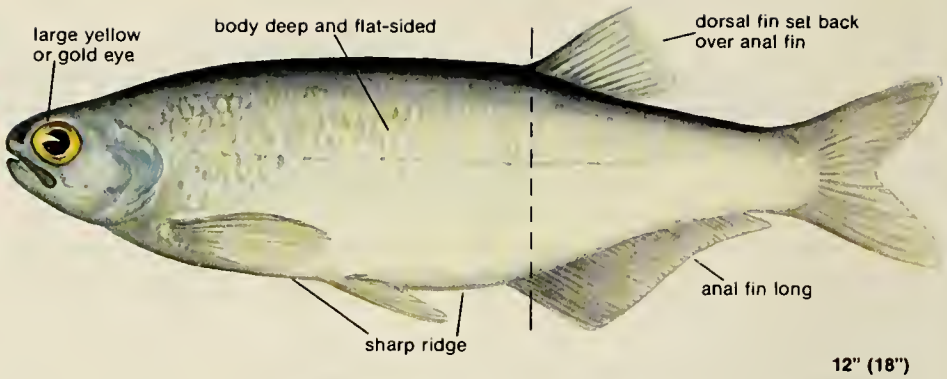
Native. Year-round population in Fort Peck Reservoir and in dredge cuts below Fort Peck Dam. Spring spawning run from North Dakota up Missouri River into Montana. Part of run branches off into Yellowstone River, while remainder continues up Missouri River to Fort Peck Dam. Also, spawning run from Fort Peck Reservoir into Missouri River. **OTHER NAME:** Spoonbill cat. **HABITAT:** Slow or quiet waters of large rivers or impoundments. Spawns on gravel bars of large rivers during spring high water. **OTHER CHARACTERISTIC:** Body naked except for scales on upper lobe of tail.

60" (72")

GOLDEYE
Hiodon alosoides



Native. **OTHER NAMES:** Skipjack, shiner, shad. **HABITAT:** Large rivers, their tributaries, reservoirs. Adapted to turbid water. **OTHER CHARACTERISTICS:** Large scales. Female has sickle-shaped anal fin (see illustration); on mature male, front rays of anal fin are longer, forming a conspicuous rounded lobe.



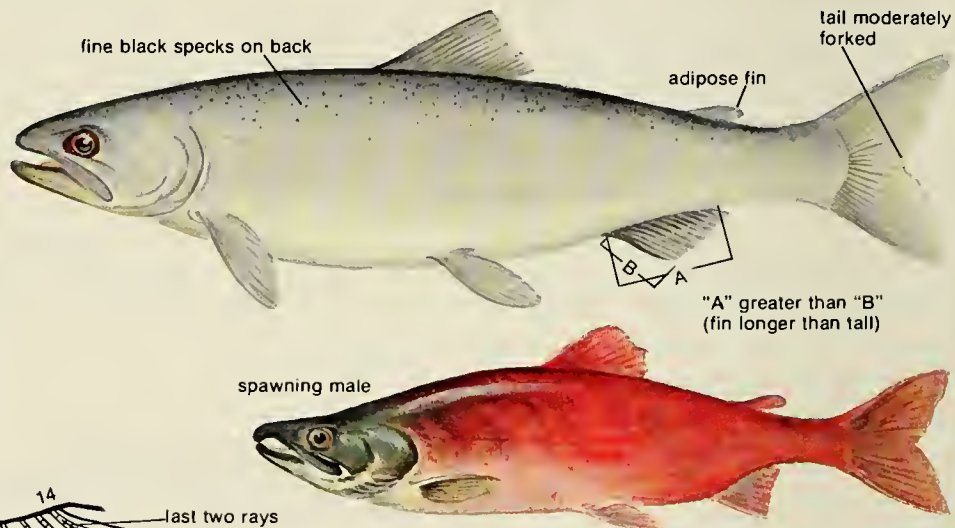
12" (18")

TROUT FAMILY

Montana members of this family are Kokanee (salmon), trouts (including chars), whitefishes and Arctic Grayling. All have an adipose fin; trouts and Kokanee have smaller scales than whitefishes and grayling. Young usually have parr marks (see Golden Trout). Colors vary with habitat, season and sex; for example, trouts living in turbid water or under ice acquire a silvery iridescence that covers spots and other colors making identification difficult.

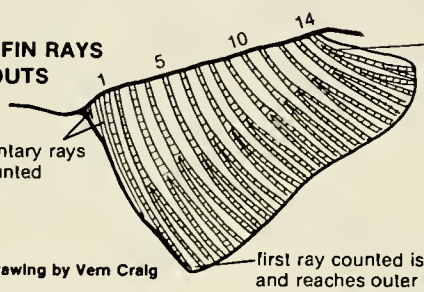
KOKANEE
Oncorhynchus nerka

Kokanee is a landlocked sockeye salmon, a Pacific salmon. It is the only salmon presently in Montana waters. Introduced. **OTHER NAMES:** Silver, kokanee salmon. **HABITAT:** Cold, clear lakes and reservoirs. Generally ascends streams to spawn. **OTHER CHARACTERISTIC:** Spawning female varies from red to dark green and may have yellow blotches. **SIMILAR SPECIES:** Silver-colored Rainbow Trout are often miscalled Kokanee. Trouts have 12 or fewer rays in anal fin (fin is taller than it is long); Kokanee has 13 or more (see diagram). Trouts have 26 or fewer gill rakers (including rudiments) on the first arch (see Pumpkinseed for diagram); Kokanee has 30 or more and these are longer.



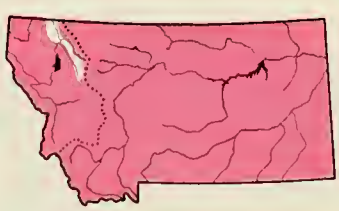
11" (18")

HOW TO COUNT ANAL FIN RAYS ON KOKANEE AND TROUTS

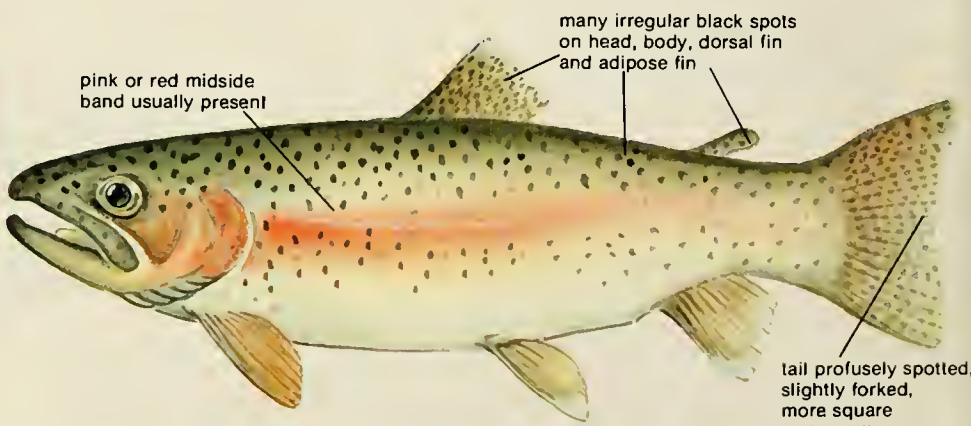

1
5
10
14
last two rays counted as one if united at their bases
rudimentary rays not counted
first ray counted is unbranched and reaches outer edge of fin

drawing by Vern Craig

RAINBOW TROUT
Salmo gairdneri

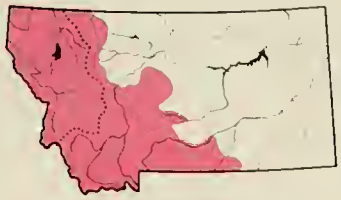


Native to Kootenai River drainage (northwestern Montana). **OTHER NAME:** Silver (a Rainbow Trout with silvery iridescence is often miscalled a silver salmon). **HABITAT:** Cool, clean streams and lakes. **SIMILAR SPECIES:** (1) Brown Trout has halos around spots and may have red spots; tail has few or no spots. See (2) Cutthroat Trout, (3) Golden Trout and (4) Kokanee.

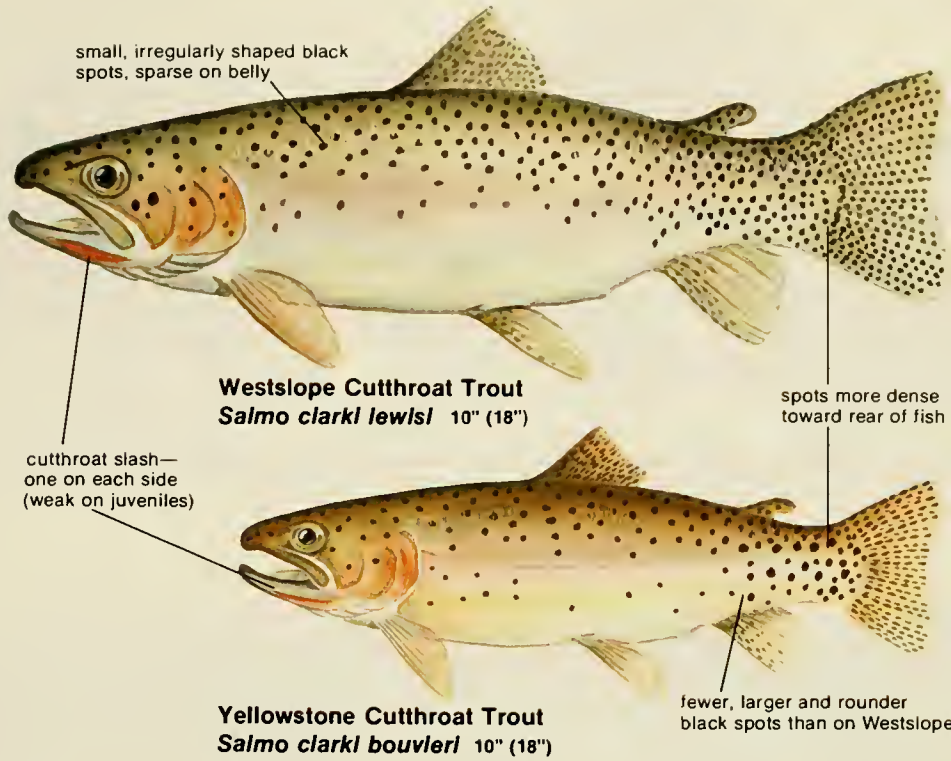

many irregular black spots on head, body, dorsal fin and adipose fin
pink or red midside band usually present
tail profusely spotted, slightly forked, more square on large fish

12" (24")

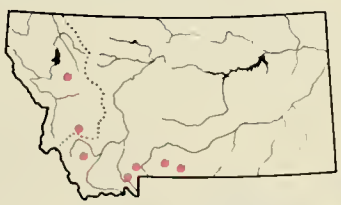
CUTTHROAT TROUT
MONTANA STATE FISH
(Two subspecies)



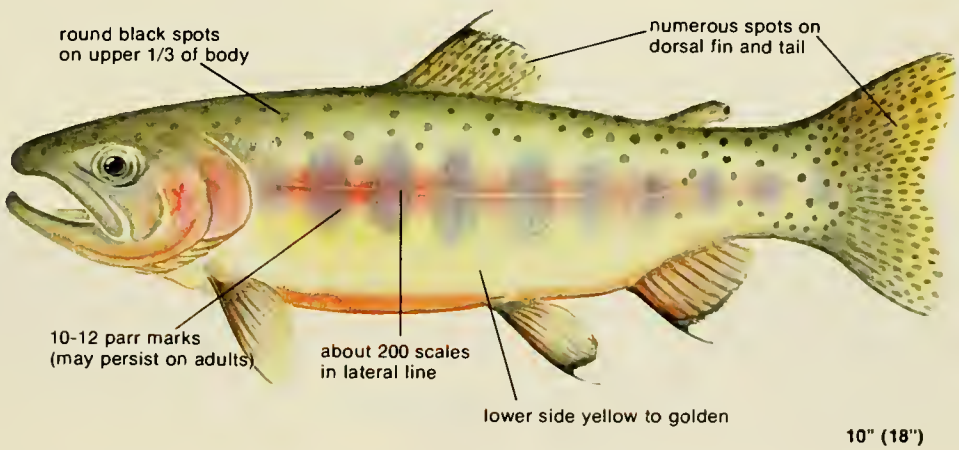
Native. Gone from much of original range. Westslope Cutthroat is native west of Continental Divide and in some drainages east of divide where it is referred to as upper Missouri Cutthroat Trout. Yellowstone Cutthroat is native in Yellowstone River drainage. **OTHER NAMES:** Blackspotted trout, blackspotted cutthroat trout, red-belly, native, flat. **HABITAT:** Cool, clear mountain streams and lakes. **OTHER CHARACTERISTICS:** Usually has small teeth on base of "tongue" that are difficult to see, but may be felt with finger. Typically does not have spots on lower fins. Spots on head, if any, are generally above eye. Usually has two dusky blotches on cheek. During spawning season, lower side of Westslope may be red and Yellowstone may have reddish cheek. Variations in color and spotting make identification difficult. **SIMILAR SPECIES:** (1) Rainbow Trout does not have teeth on base of "tongue" or distinct red "cutthroat slashes," although some may have faint slashes. It usually has a broad pink or red midside "rainbow band." See (2) Golden Trout and (3) Brown Trout. Crosses between the cutthroat subspecies are common as are crosses between Cutthroat and Rainbow trouts; crosses are difficult to identify.


small, irregularly shaped black spots, sparse on belly
Westslope Cutthroat Trout
Salmo clarki lewisi 10" (18")
spots more dense toward rear of fish
cutthroat slash—one on each side (weak on juveniles)
fewer, larger and rounder black spots than on Westslope
Yellowstone Cutthroat Trout
Salmo clarki bouvieri 10" (18")

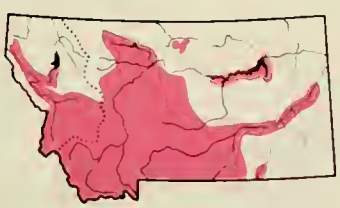
GOLDEN TROUT
Salmo aguabonita



Introduced. Ten Montana lakes or lake chains in areas designated on map have pure strain Golden Trout. Numerous lakes have a Golden Trout-Rainbow Trout hybrid or Golden Trout-Cutthroat Trout hybrid. **HABITAT:** Does well in harsh conditions of alpine lakes and streams. Also successful in clear, cold lakes at lower elevations. **OTHER CHARACTERISTIC:** White tip on dorsal, anal and pelvic fins not always set off by black line. **SIMILAR SPECIES:** (1) Rainbow Trout is densely covered with irregularly shaped dark spots and has 160 or fewer scales in lateral line (these are the pored scales along the midside; they are counted from the gill opening to the tail, excluding the last small scales at base of tail fin). (2) Cutthroat Trout has cutthroat slashes; usually has teeth on base of tongue; pelvic and anal fins do not have white tips.


round black spots on upper 1/3 of body
numerous spots on dorsal fin and tail
10-12 parr marks (may persist on adults)
about 200 scales in lateral line
lower side yellow to golden
10" (18")

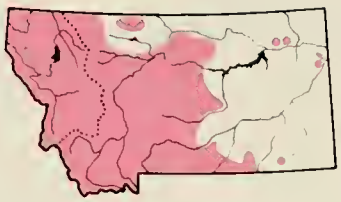
BROWN TROUT
Salmo trutta



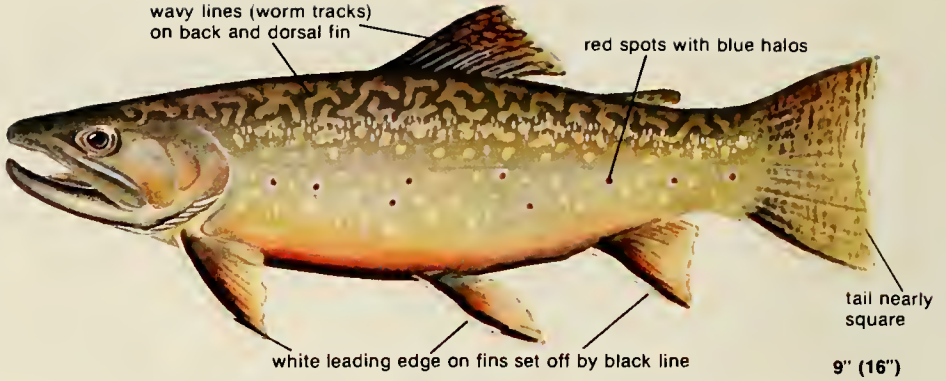
Introduced. **OTHER NAMES:** German brown (Von Behr), Loch Leven (these were the original strains that are now mixed and indistinguishable). **HABITAT:** Lower reaches of large streams. Reservoirs and lakes with suitable spawning tributaries. **OTHER CHARACTERISTICS:** May lack red spots. Black (or brown) spots may be irregularly shaped or rounded. **SIMILAR SPECIES:** (1) Cutthroat Trout has cutthroat slashes and only black spots. (2) Young Brook Trout could be mistaken for young Brown Trout, but has intense white edge on anal and paired fins. (3) See Rainbow Trout.

background color usually golden-brown
tail squarish with few spots or none
black or brown spots often with light halos
red spots on sides with light halos
13" (24")

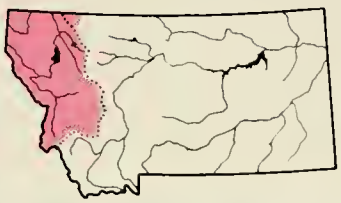
BROOK TROUT
Salvelinus fontinalis



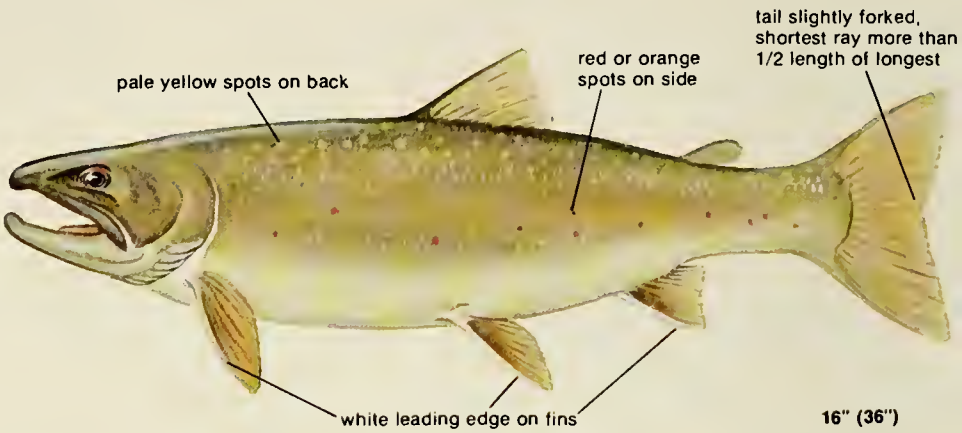
Introduced. **OTHER NAMES:** Eastern brook trout, brookie. **HABITAT:** Prefers small spring-fed streams and ponds. Has become widespread in clear, cold lakes and streams. **SIMILAR SPECIES:** (1) Bull Trout does not have spots with blue halos or wavy lines on back. (2) Lake Trout has deeply forked tail and no red spots or halos around spots. (3) See Brown Trout. Brook, Bull and Lake trouts (all in genus *Salvelinus*) are chars. They have light spots on a dark background, whereas true trouts (genus *Salmo*) have dark spots on a light background.


wavy lines (worm tracks) on back and dorsal fin
red spots with blue halos
tail nearly square
white leading edge on fins set off by black line
9" (16")

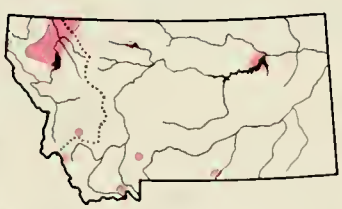
BULL TROUT
Salvelinus confluentus



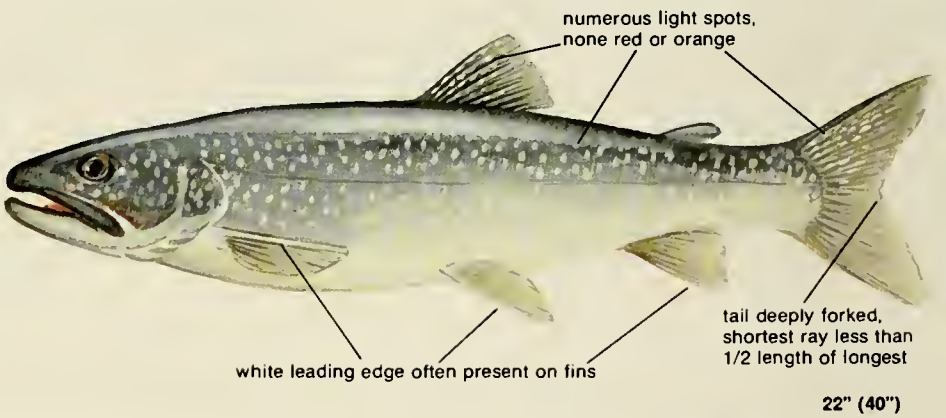
Native. **OTHER NAMES:** Called Dolly Varden until 1978 when the primarily inland form of the Dolly Varden was designated a separate species, Bull Trout. **HABITAT:** Does best in large cold-water streams and lakes, but also found in smaller bodies of water. Lake dwellers ascend streams to spawn. **OTHER CHARACTERISTIC:** Dorsal fin and tail sometimes have a few pale spots. **SIMILAR SPECIES:** See (1) Lake Trout and (2) Brook Trout.


tail slightly forked, shortest ray more than 1/2 length of longest
red or orange spots on side
pale yellow spots on back
white leading edge on fins
16" (36")

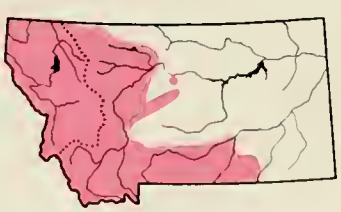
LAKE TROUT
Salvelinus namaycush



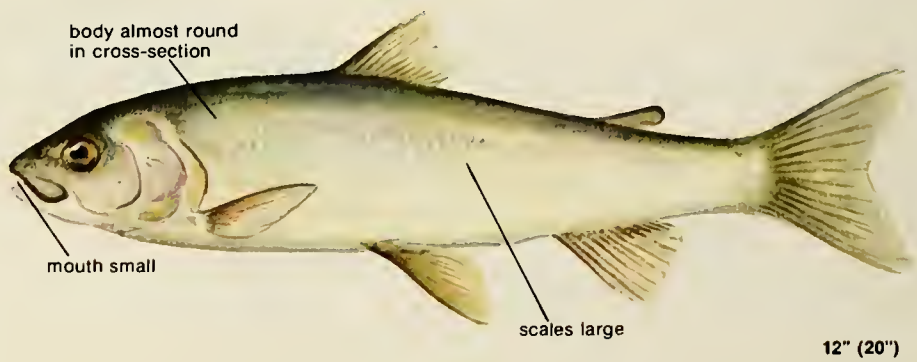
Native in Elk, Twin, St. Mary and Waterton lakes. **OTHER NAMES:** Mackinaw trout, mackinaw. **HABITAT:** Deep, cold lakes and reservoirs. **OTHER CHARACTERISTICS:** May have wavy lines on back. Fins may have traces of orange. **SIMILAR SPECIES:** (1) Bull Trout has many fewer spots and some that are orange and red; tail not as deeply forked; dark background color does not extend as far down side. (2) See Brook Trout.


numerous light spots, none red or orange
tail deeply forked, shortest ray less than 1/2 length of longest
white leading edge often present on fins
22" (40")

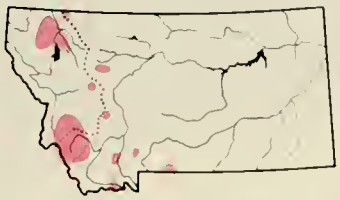
MOUNTAIN WHITEFISH
Prosopium williamsoni



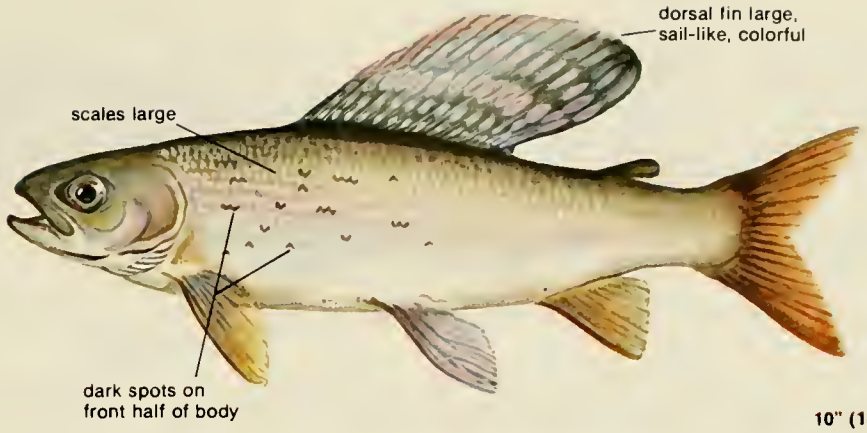
Native. **OTHER NAME:** Rocky Mountain whitefish. **HABITAT:** Common in medium-sized and large, clear, cold rivers. Also found in some lakes and reservoirs. **OTHER CHARACTERISTIC:** Teeth few, small; hardly discernible. **SIMILAR SPECIES:** (1) Lake Whitefish (deep and slab-sided) and (2) Pygmy Whitefish (only reaches 7 inches) are found in a few Montana lakes (neither fish shown). (3) Trouts and (4) Kokanee have larger mouths and smaller scales. (5) A minnow or sucker (neither shown) does not have an adipose fin. (6) See Arctic Grayling.



ARCTIC GRAYLING
Thymallus arcticus

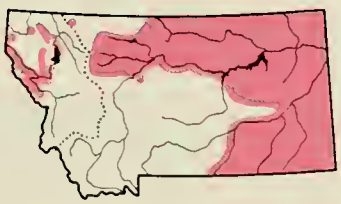


Native. **OTHER NAME:** Montana grayling. **HABITAT:** Historically a stream fish. Now mostly in mountain lakes where introductory plants have been made. Spawns in streams or sometimes in lakes. **SIMILAR SPECIES:** (1) Whitefishes and (2) trouts do not have sail-like dorsal fin.

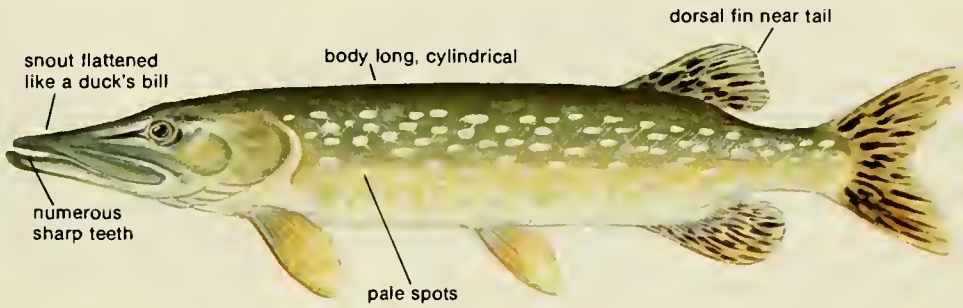


10" (18")

NORTHERN PIKE
Esox lucius



Native in St. Mary River drainage. **OTHER NAMES:** Pike, northern, pickerel, jack, hammer-handle, slimer. **HABITAT:** Lakes, reservoirs and large streams; avoids strong currents. Spawns in areas with dense vegetation.



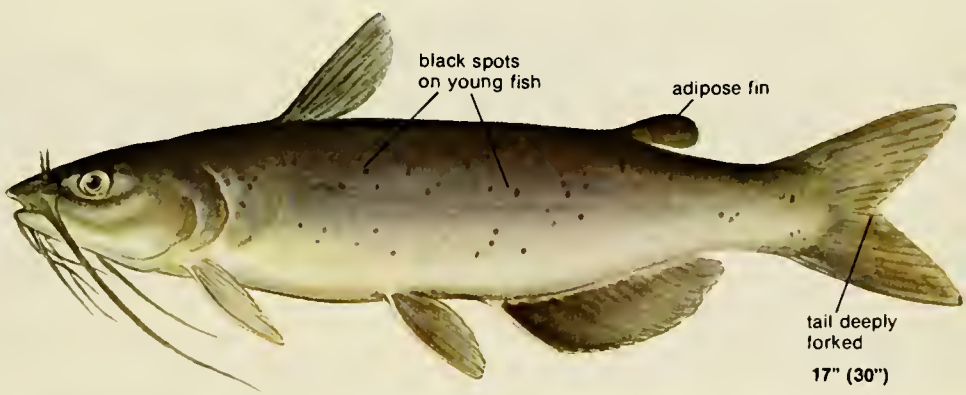
20" (45")

CATFISH FAMILY

This family is characterized by scaleless fishes with long "cat's whiskers" (barbels) and an adipose fin.

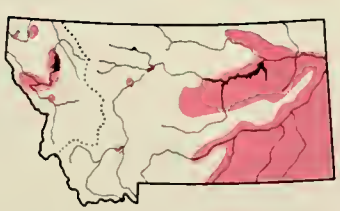
CHANNEL CATFISH
Ictalurus punctatus

Native. **HABITAT:** Prefers large rivers and lowland lakes. Tolerates turbid water. **SIMILAR SPECIES:** (1) Other Montana members of the catfish family do not have a deeply forked tail. (2) See Burbot.

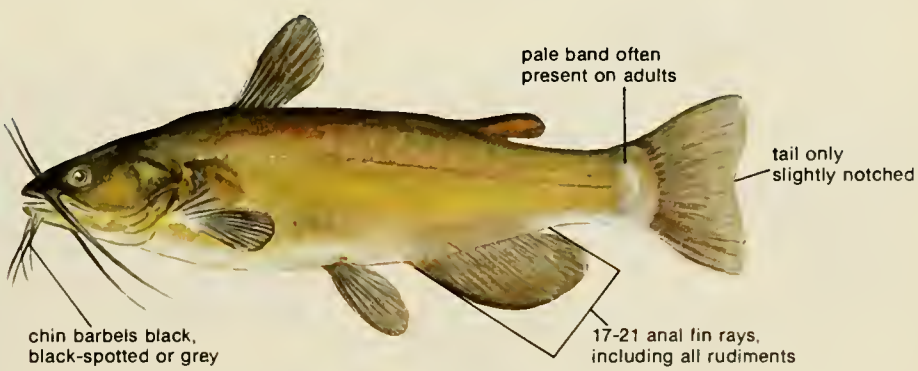


17" (30")

BLACK BULLHEAD
Ictalurus melas

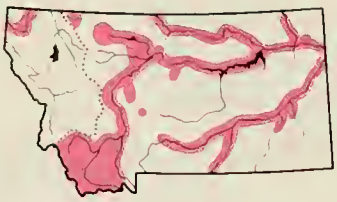


Introduced. **HABITAT:** Mud-bottomed lakes and ponds; pools and backwaters of streams. Tolerates turbidity, warm temperatures and low levels of dissolved oxygen. **OTHER CHARACTERISTIC :** Membranes between fin rays much darker than rays. **SIMILAR SPECIES:** (1) Yellow Bullhead (not shown) found in a few Montana waters; has white, yellow or pink chin barbels (no black pigment) and 24 or more rays in anal fin. (2) Stonecat (not shown) is small (typical length, 6"; usual maximum, 9") and slender, with square or rounded tail. Distinguished from other family members by its adipose fin which, rather than flap-like, is attached to the body along its entire length and is separated from the tail by a notch. See (3) Channel Catfish and (4) Burbot.


pale band often present on adults
tail only slightly notched
chin barbels black, black-spotted or grey
17-21 anal fin rays, including all rudiments

7" (12")

BURBOT
Lota lota

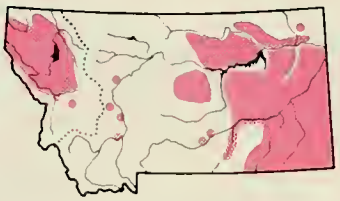


Native. **OTHER NAME:** Ling **HABITAT:** Large rivers; cold, deep lakes and reservoirs. **OTHER CHARACTERISTIC.:** Skin appears smooth, but tiny embedded scales are visible under magnification. **SIMILAR SPECIES:** Told from (1) catfishes and (2) bullheads by single barbel, round tail and very long dorsal and anal fins.

SUNFISH FAMILY

This is a family of spiny-rayed fishes—black basses, sunfishes, rock bass and crappies. The dorsal fin has a spiny front portion and a soft-rayed rear portion which are broadly (or, in the black basses, narrowly) joined into a single fin. The paired fins are nearly one above the other.

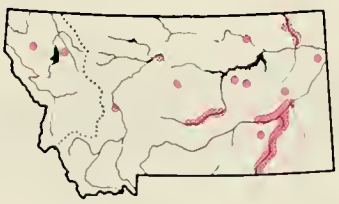
LARGEMOUTH BASS
Micropterus salmoides



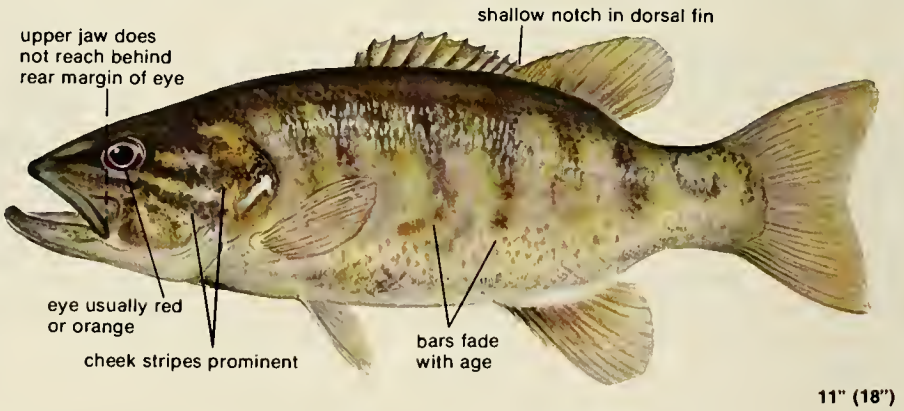
Introduced. **OTHER NAME:** Largemouth black bass. **HABITAT:** Clear, mud-bottomed lakes and stream backwaters. Seeks areas with comparatively warm summer water temperatures and ample aquatic vegetation. **OTHER CHARACTERISTIC:** Length of longest dorsal spine at least twice the length of shortest dorsal spine at notch. **SIMILAR SPECIES:** Smallmouth Bass has smaller mouth, broader connection between spiny and soft-rayed portion of dorsal fin, is more streamlined, tends to brownish hue (Largemouth to blackish) and has a different color pattern.

dorsal fin almost completely divided by deep notch
upper jaw reaches behind rear margin of eye in adult
dark midside band (faded or absent on adults)
11" (18")

SMALLMOUTH BASS
Micropterus dolomieui

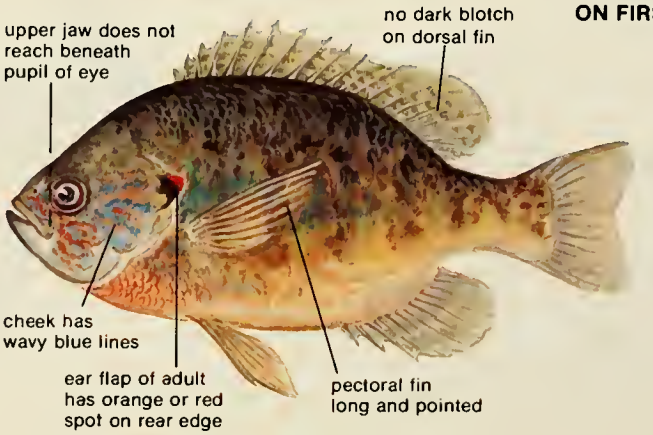


Introduced. **OTHER NAMES:** Northern smallmouth bass, smallmouth black bass, bronze-back. **HABITAT:** Over boulders and to lesser extent over gravel in cool, clear rivers and lakes. **OTHER CHARACTERISTICS:** Length of longest dorsal spine is less than twice the length of shortest dorsal spine at notch. Young have tri-colored tail with yellow or orange base, dark vertical bar in center and white outer edge. **SIMILAR SPECIES:** See Largemouth Bass.

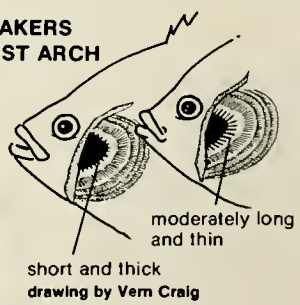

shallow notch in dorsal fin
upper jaw does not reach behind rear margin of eye
eye usually red or orange
cheek stripes prominent
bars fade with age
11" (18")

PUMPKINSEED
Lepomis gibbosus

ntroduced. **OTHER NAMES:** Pumpkinseed unfish, common sunish. **HABITAT:** Ponds, mall lakes, margins of arge lakes and slow treams. Prefers areas vith aquatic vegetation nd submerged brush. **)THER CHARACTER-STIC:** Gill rakers short and thick (see diagram). **SIMILAR SPECIES:** (1) Bluegill has completely black ear flap, longer gill akers and black blotch on rear of dorsal fin. Bluegills and 'umpkinseeds readily hybridize; hybrids have intermediate haracteristics. See (2) Green Sunfish and (3) Rock Bass.

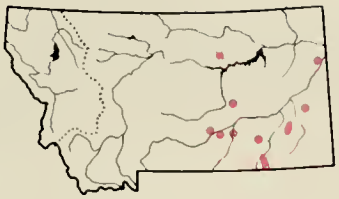

upper jaw does not reach beneath pupil of eye
no dark blotch on dorsal fin
cheek has wavy blue lines
ear flap of adult has orange or red spot on rear edge
pectoral fin long and pointed
6" (8")

GILL RAKERS ON FIRST ARCH

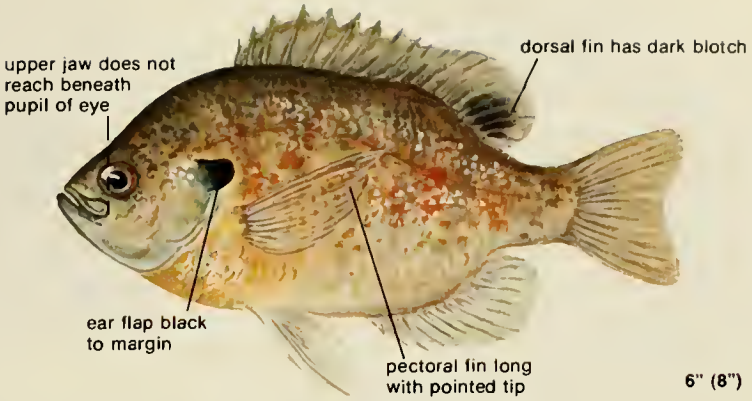


drawing by Vern Craig

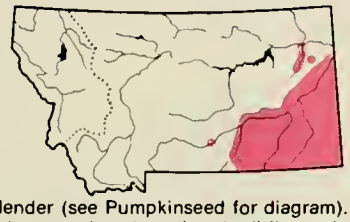
BLUEGILL
Lepomis macrochirus



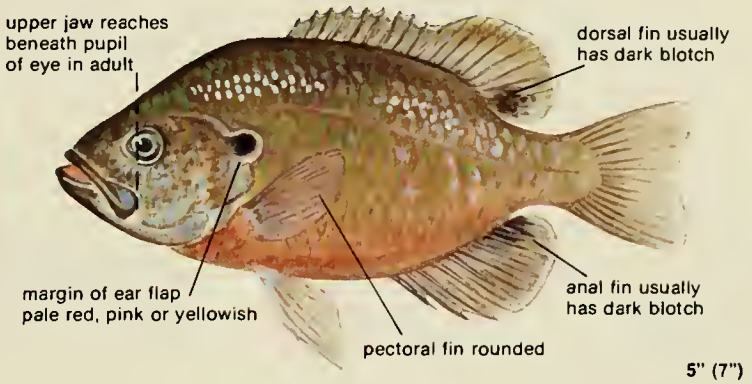
Introduced. **OTHER NAME:** Bluegill sunfish. **HABITAT:** Areas of aquatic vegetation in comparatively warm ponds and lakes; slow, weedy streams. **OTHER CHARACTERISTICS:** Gill rakers moderately long and slender (see Pumpkinseed for diagram). Ear flap smaller on females and young males than on adult males. **SIMILAR SPECIES:** See (1) Pumpkinseed, (2) Green Sunfish and (3) Rock Bass.


upper jaw does not reach beneath pupil of eye
dorsal fin has dark blotch
ear flap black to margin
pectoral fin long with pointed tip
6" (8")

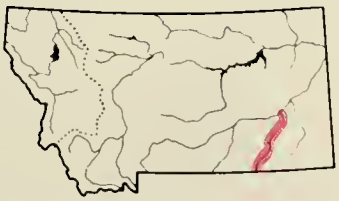
GREEN SUNFISH
Lepomis cyanellus



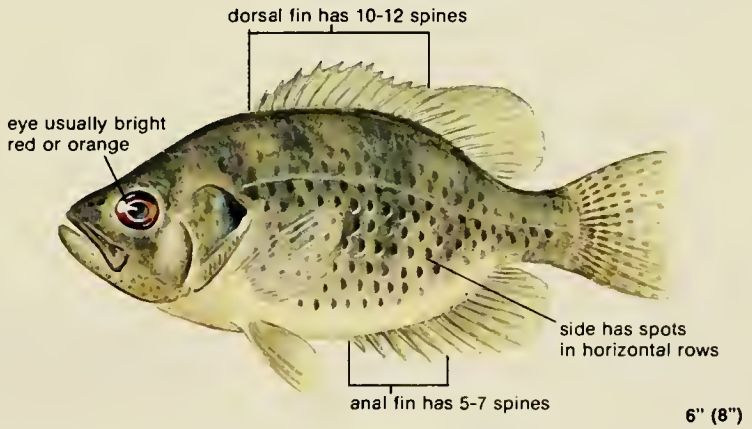
Introduced. **HABITAT:** Slow-moving streams at lower elevations and shallows of lakes. Tolerance of high turbidity, low levels of dissolved oxygen and a wide range of temperatures allow it to survive in isolated pools of streams which cease to flow in dry weather. **OTHER CHARACTERISTICS:** Comparatively thick-bodied. Gill rakers long and slender (see Pumpkinseed for diagram). Breeding males have light-colored fringe on dorsal, anal and tail fins as in picture. **SIMILAR SPECIES:** (1) Bluegill and (2) Pumpkinseed have smaller mouth and pointed, usually longer, pectoral fins. Bluegill has completely black ear flap; Pumpkinseed has short, thick gill rakers; both are usually deeper-bodied than Green Sunfish. (3) See Rock Bass.


upper jaw reaches beneath pupil of eye in adult
dorsal fin usually has dark blotch
margin of ear flap pale red, pink or yellowish
anal fin usually has dark blotch
pectoral fin rounded
5" (7")

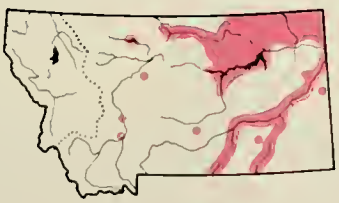
ROCK BASS
Ambloplites rupestris



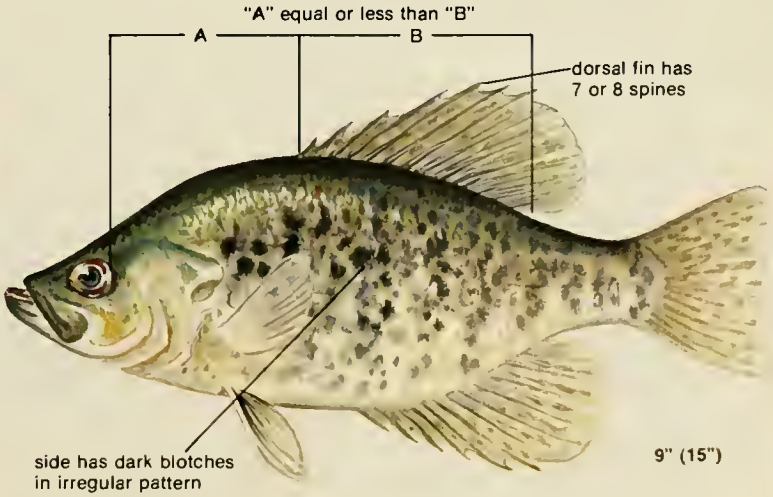
Introduced into Wyoming portion of Tongue River and moved downstream into Montana. **OTHER NAMES:** Northern rock bass, redeye, goggle eye. **HABITAT:** Rocky-bottomed, clear, comparatively warm streams. **OTHER CHARACTERISTIC:** Body robust. **SIMILAR SPECIES:** (1) Sunfishes and (2) crappies are not as thick and heavy and lack the red eye. Sunfishes have only 3 spines in the anal fin; crappies have 8 or fewer spines in the dorsal fin and the anal fin is about as long as the dorsal.



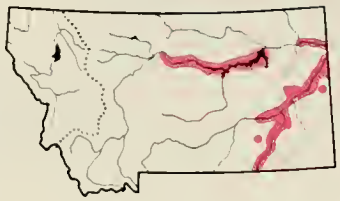
BLACK CRAPPIE
Pomoxis nigromaculatus



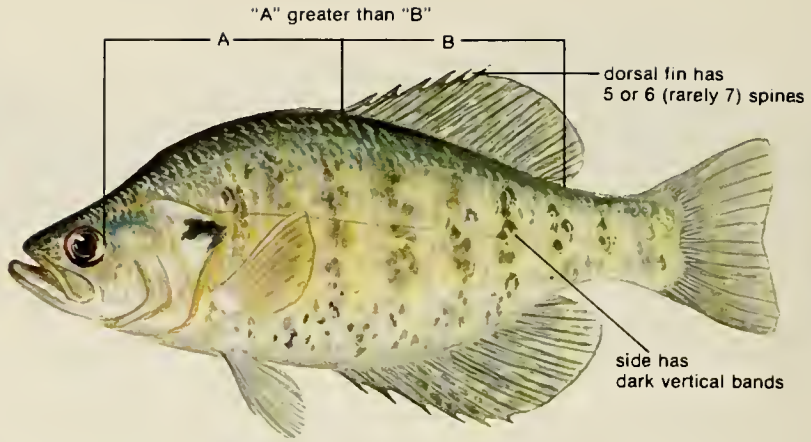
Introduced. **HABITAT:** Lakes, reservoirs and slow portions of streams in areas with sandy to mucky bottoms and aquatic vegetation. **OTHER CHARACTERISTICS:** Anal fin base about as long as dorsal fin base. Fish from turbid water may be lighter colored. **SIMILAR SPECIES:** White Crappie's dorsal fin is shorter, set farther back and has 5 or 6 spines (rarely 7), compared with the Black Crappie's 7 or 8. White Crappie has vertical bars on side.



WHITE CRAPPIE
Pomoxis annularis



Introduced. **HABITAT:** Lakes and reservoirs and slow portions of streams. More tolerant of turbidity than Black Crappie. **OTHER CHARACTERISTIC :** Anal fin base usually longer than dorsal fin base. **SIMILAR SPECIES:** See Black Crappie.

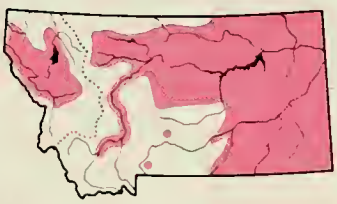


9" (15")

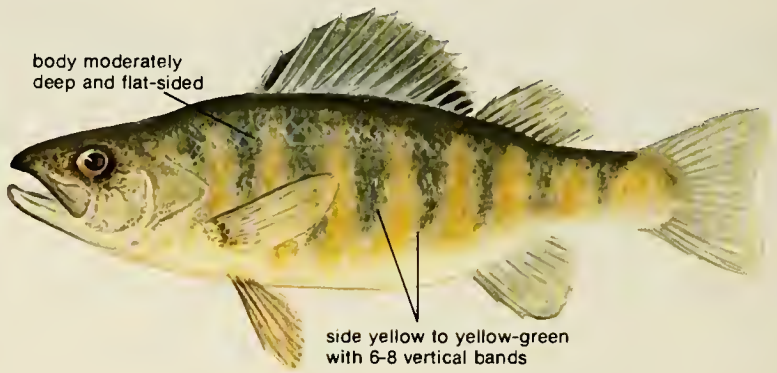
PERCH FAMILY

These spiny-rayed fishes have two separate dorsal fins—the front one with spines, the rear one with all or mostly soft rays. The paired fins are nearly one above the other.

YELLOW PERCH
Perca flavescens

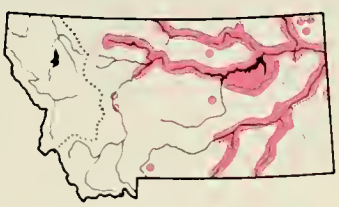


Introduced. **OTHER NAME:** Perch. **HABITAT:** Warm to cool, clear lakes with moderate vegetation and, to a lesser extent, slow, weedy streams. **OTHER CHARACTERISTICS:** Many small teeth but no long ("canine") teeth. Anal fin has 2 spines and 6-8 soft rays. **SIMILAR SPECIES:** Small Yellow Perch might be mistaken for young Walleye or Sauger. The latter two have large "canine" or tearing teeth and 11-14 soft rays in the anal fin.



8" (12")

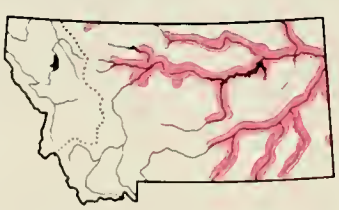
WALLEYE
Stizostedion vitreum



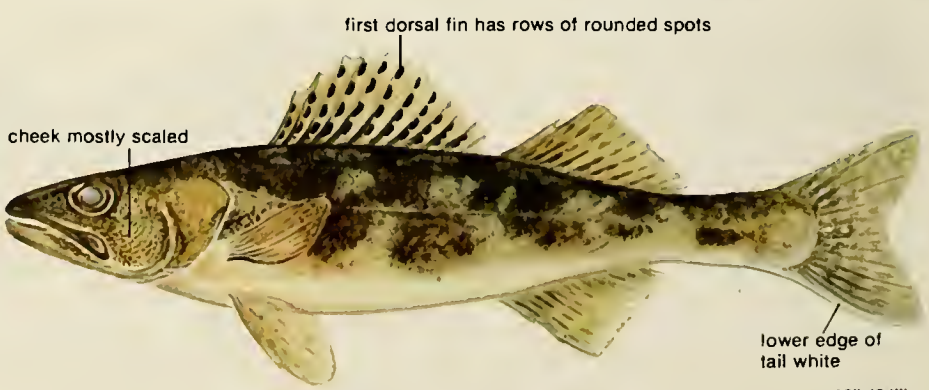
Introduced. **OTHER NAME:** Wall-eyed pike. **HABITAT:** Primarily large lakes and reservoirs; to a lesser extent, rivers. **OTHER CHARACTERISTICS:** Often has golden hue. Jaws and roof of mouth have long ("canine") teeth. Anal fin has 2 spines and 11-14 soft rays. **SIMILAR SPECIES:** See (1) Sauger and (2) Yellow Perch.

16" (30")

SAUGER
Stizostedion canadense



Native. **OTHER NAME:** Sand pike. **HABITAT:** Rivers, shallows of lakes and reservoirs. Prefers turbid water. **OTHER CHARACTERISTICS:** Often has greyish hue with dark blotches. Jaws and roof of mouth have long ("canine") teeth. Body almost round. Anal fin has 2 spines and 11-14 soft rays. **SIMILAR SPECIES:** (1) Walleye has large, dark spot at rear of first dorsal fin; tip of lower lobe of tail is white; cheeks have few scales, if any. (2) See Yellow Perch.



13" (24")

Water, Water Everywhere, But...

IN ITS thousands of miles of rivers and streams, in its hundreds of lakes and reservoirs, Montana is gifted with a rare abundance of good fishing water, offering all manner of delightful angling challenges. But the first, and sometimes the biggest, challenge is gaining access. Fortunately, down through the years, most of Montana's private landowners have been generously tolerant. But fishing pressure has increased greatly in the past 20 years (173,000 Montanans went fishing in 1979, joined by more than 50,000 nonresidents), and so has the traffic across private land; this has led to inevitable impacts, unnecessary abuses and—in some cases—"No Fishing" signs.

To alleviate this problem, the Department of Fish, Wildlife and Parks established a system of 200 state-owned fishing access sites, most of which were acquired and developed during the past 16 years under the stewardship of the Parks Division. The sites are small (mostly under 30 acres), modestly developed (a gravel road, a parking area, sometimes a fireplace, an outhouse, a boat ramp or other minor improvements) and they are relatively inexpensive. But they are not cheap. They are financed *only partly* with fishing license revenues. In fact, although stream access may still seem insufficient, Montana fishermen are actually getting considerably more access than they themselves pay for.

The reasons for this situation are complex, and involve three important events:

1) In 1964, Congress established the federal Land and Water Conservation Fund (LWCF), with a mandate to assist the states in providing a variety of outdoor recreation opportunities. The money in this fund comes from oceanic mineral leases, from a federal tax on motorboat fuel, from fees collected at federal recreation areas and from sale of surplus federal land. A large part of the money is passed along to the states in the form of matching grants for projects enhancing outdoor recreational opportunities. Montana has received over $25 million from the fund, including more than $10 million for state parks, recreation areas and fishing access sites. More than half of the present 200 access sites have been acquired and opened or improved with the aid of LWCF grants.

But these LWCF grants cover no more than 50% of any recreation project; the federal dollars must be matched equally by another sponsor. So when the LWCF supplies half the purchase price for a fishing access site, where does the other half come from? During the early years, it was drawn from the department's general hunting and fishing license account. As late as 1973, the Legislature approved spending $500,000 from that account—to buy $1 million worth of access. Then another change was made.

2) In 1974, Montana fishermen successfully backed a law that earmarks a portion of each fishing license fee to go into a special account, reserved for access acquisition. One dollar from each resident fishing license, $1 from each nonresident day tag and $5 from each large nonresident fishing license, now go into that earmarked account—which adds up to roughly $450,000 a year. This would mean a great bounty of new access, but for one catch: The 1974 law specified that 100% of the earmarked account should go to purchasing land, *none* to development and operations. Fishermen had lobbied to buy themselves river front acreage. But who was to pay for their fences, their parking areas, their gravel roads? It costs roughly $20,000 to make the simple improvements that turn a plot of river bank into a durable fishing access site. No provision had been made for those costs.

3) In 1977, the earmarking law was amended in the right direction, but inadequately: 15% of the earmarked account may now be spent on preparation and maintenance of sites. The other 85% is still reserved strictly for new purchases. Today, this arrangement represents the single most serious bottleneck in the fishing access program. A 15% share of the earmarked fund is simply not enough to pay for basic upkeep on Montana's existing fishing sites—let alone to allow developing any new ones. Not enough and not even close: The share earmarked for maintenance actually covers less than *one-fifth* of what it should.

Where has the rest of the money been coming from to do minimal upkeep, to empty trash and repair fences, to protect stream bank and water quality from the impacts of heavy traffic? It has been coming, at the rate of $250,000 to over $300,000 a year, from the general license account—and more money is needed to do a minimally acceptable job at all sites. Who supports that account? Fishermen and hunters, but mainly hunters—as much as 40% of it, in fact, from nonresident hunters.

As land increases in value, it will become more and more difficult for the department to expand the fishing access system. But without adequate funding to maintain the sites already in the system, it compounds the problem to add more. There may be a bright spot on the horizon, however. Legislation has been proposed to raise the percentage of the earmarked fishing access acquisition account that can be used for maintenance and development of existing sites. Enactment of this legislation would go a long way toward correcting the problems with the current fishing access system.

Editor's note—*As this issue of* Montana Outdoors *went to press, the fate of HB 806, a bill that would permit up to 50% of the earmarked fishing access acquisition account to be used for maintenance and development of existing access sites, was undecided. By the time this reaches our readers, the Montana Legislature will have acted on this and other department financial matters affecting the fishing access system.*■

1980 Fishing Records Summary

painting by Charles J. Fritz

Three Montana fishing records were broken in 1980—burbot (ling), channel catfish and largemouth bass. The records for the three species had stood since 1977, 1978 and 1973, respectively.

To be included on the state records list, we require that the fish 1) be legally harvested, 2) be weighed on an inspected scale (most grocery store scales are certified and inspected) and 3) be positively identified. To maintain the list's integrity and to protect current record holders, we ask that a record fish be documented and verified by department personnel *whenever possible.* If a department employee is unavailable, the angler must present a photograph from which the fish can be properly identified. However, identification by photograph is difficult with some species.

1980 Fishing Records Summary

Species	Weight lbs.	ozs.	Angler	Year	Location
Bigmouth buffalo	32	6	Gary Lundman	1979	Missouri River (Slippery Ann Game Station)
Black bullhead	1	11	Mike Mitchell	1977	Horse Creek (McCone Co.)
Black crappie	3	2	Al Elser	1973	Tongue River Reservoir
Bluegill	2	8	George Schlosser	1967	Dengel Reservoir
Brook trout	9	1	John R. Cook	1940	Lower Two Medicine Lake
Brown trout	29	0	E. H. "Peck" Bacon	1966	Wade Lake
Burbot (ling)*	**13**	**4**	**Paul Keller, Ernie Schutt**	**1980**	**Missouri River (below Fort Peck Dam)**
Channel catfish*	**23**	**4**	**Larry Hamilton**	**1980**	**Milk River**
Coho salmon	4	14	Irven Stohl	1973	Fort Peck Reservoir
Cutthroat trout	16	0	William D. Sands	1955	Red Eagle Lake
Dolly Varden	25	10	James Hyer	1916	Unknown
Drum	13	6	George Gallagher	1973	Fort Peck Reservoir
Golden trout	2	9	Raymond D. Gallik	1975	Lightning Lake
Goldeye	2	9	Lester Estenson	1977	Nelson Reservoir
Grayling	2	10	Mark Daniels	1974	Handkerchief Lake
King salmon (chinook)	4	7	Berry Gillis	1972	Missouri River
Kokanee salmon	5	15	Forrest Johnson	1976	Pishkun Reservoir
Lake trout	42	0	Dave Larson	1979	Flathead Lake (east shore)
Lake whitefish	4	7½	Jim Frame	1978	Echo Lake
Largemouth bass*	**7**	**8**	**Bruce Blanknek**	**1980**	**Kicking Horse Reservoir**
Mountain whitefish	4	9¾	Mike Hangas	1977	Blackfoot River
Northern pike	37	8	Lance Moyler	1972	Tongue River Reservoir
Paddlefish	142	8	Larry Branstetter	1973	Missouri River
Pallid sturgeon	60	0	Gene Sattler	1979	Yellowstone River
Rainbow trout	20	0	C. J. Brohaugh	1952	Cliff Lake
Rainbow-cutthroat hybrid	17	10	R. A. Rousselle	1973	Ashley Lake
Sauger	7	2	Raymond V. Johnston	1975	Tongue River Reservoir
Shortnose gar	3	1	John Johnson	1977	Fort Peck Dredge Cuts
Shovelnose sturgeon	12	12	Troy Sidewell	1978	Marias River at Loma
Smallmouth bass	4	11½	Bob Higson	1975	Horseshoe Lake
Smallmouth buffalo	9	4	Mac McKinney	1977	Hauser Lake (west side)
Squawfish	6	10	Rick Norris	1979	Flathead Lake (Polson Bridge)
Walleye	14	0	Neil Berg	1974	Nelson Reservoir
White crappie	2	2	Drew Jackson	1978	Tongue River Reservoir
White sturgeon	96	0	Herb Stout	1968	Kootenai River
White sucker	3	7	Jim Crants	1978	Nelson Reservoir
Yellow perch	2	0	Gerald Pottratz	1974	Nelson Reservoir

*New Montana records for 1980

HUNTING and FISHING
C.C.B. CO.
LURE
No.
CHARLES FRITZ

About The Writers

• **David Quammen's** words and rivers have at least two things in common: Both are living, and, at their best, both flow freely. In "Living Water," he writes: "Water came first, necessarily. Without life, there would still be water. Without water, no life." Living, flowing words. And the essence of truth about rivers, because their lives are precarious and the balance is delicate—the water never stops moving; the pressure never relents. Quammen's contributions to the issue go far beyond his article; his influence is felt in the issue's organization, in the way its words and pictures come together, and in its message. He previously served as an editorial consultant at *Montana Outdoors,* working on the Jan./Feb. 1980 issue and on our Special Hunting Issue. He continues to live in Ennis where he writes and works as a part-time fishing guide. "Living Water" begins on page 2.

• Beginning on page 7, five of the department's fish specialists explain some of the techniques used in "Fisheries Management." **Ron Marcoux,** fisheries manager for Region 3 (Bozeman), examines "Special Regulations for Larger Trout: Is Montana Ready?" As he notes, if you give most fishermen a choice, they'll keep the "big ones" and throw back the smaller fish; this selective harvest can reduce the numbers of big trout, especially in heavily fished waters. In "Lake Population Census: Sounding Out Secrets," **Laney Hanzel** explains some of the ways in which researchers gather information about fish in Montana lakes. Hanzel has been involved in fisheries management and research in Region 1 (Kalispell) since 1959; he currently heads the Flathead Lake Fish Study. In "Electrofishing: Using Current to Count," **Dick Vincent** writes: "Shocking, or electrofishing, is in fact the most effective means we have to sample and study stream fisheries." Vincent is a fisheries and wildlife biologist in Bozeman; he has conducted studies on the Madison River since 1966. **George D. Holton** examines "The Role of the Hatchery: Then and Now." Holton is the assistant administrator of the Fisheries Division; read on for details about his identification guide, also in this issue. In "Underwater Census: The Waterproof Biologist," **Patrick Graham** adds a touch of humor to the task of counting fish beneath some of Montana's small streams and medium-sized rivers. Graham is project leader for the Flathead River Basin Studies and works out of the Kalispell regional headquarters.

• "The Saga of Old #134" is simply that—the story of a brown trout, hardly anything unique in the Big Hole River. But "Old #134" became pretty special to **Jerry Wells** and other fisheries biologists. "Old #134" was anonymous until a September day in 1970 when he was first tagged and other information about him was recorded. He was captured in 1977, '78 and again in the spring of '79—at 11 years old, an unbelievable age for a brown trout. Turn to page 16 for a warm-hearted fish tale that might not yet be over. Wells' other contribution to this water-oriented issue discusses "Spring Creeks: Montana's Fragile Fishery." He characterizes the spring creek fishery as "...a more fragile and delicate resource that one hears less about." If you're curious about what many believe is the ultimate test of angling skill, turn to page 33. Wells is currently involved in long-term research on the relationship between flow regimes and wild trout populations in the Beaverhead, Big Hole and Ruby rivers.

• This issue contains what promises to be a section often used by anyone who wields a fly rod, or who possesses a spin-casting outfit, or who opts for a lazy trolling down the river on a Sunday afternoon. It's **George D. Holton's** "Identification of Montana's Most Common Game and Sport Fishes." It tells whether the species is native or was introduced, its scientific and common names, other names with which you might be more familiar or which are locally popular, details about habitat, other characteristics to help you identify the fish and characteristics of similar species with which you might confuse it. It that's not enough, each of the fishes discussed is featured in a full-color painting by **Glenn West.** Line drawings by **Vern Craig** assist with a few of the more technical aspects of identification. This helpful guide begins on page 19.

• Along with the spring creeks discussed in Jerry Wells' article, Montana has another unusual fishery: "Alpine Lakes: Fish Among the Clouds." And Montana's high country is replete with a wonderland of these alpine gems. As **Pat Marcuson** writes: "These lakes vary widely in size...in shape, and in depth. They may be perched anywhere from 4,000 feet to 11,250 feet above sea level. They may nestle within a remote wilderness or on private property." But they are not exempt from environmental problems and they "need a watchful eye...to preserve their special characters." Marcuson is a fisheries and wildlife biologist in Red Lodge; he has behind him more than 12 years study of fish populations in alpine lakes. Turn to his article on page 31.

• Is fishing for something other than trout like peanut butter without jelly, or apple pie without ice cream? Not according to two experts on Montana's "Warm-Water Fisheries," **Al Elser** and **Jim Liebelt.** Elser writes about the "Prairie Gold Mine" awaiting those who fish the plains' reservoirs, streams and ponds and search for northerns, walleye, sauger, bass, crappie and a host of other species. Elser is the fisheries manager for Region 7 (Miles City). Liebelt tells the story of "The Walleye of Fort Peck Reservoir." He notes the popularity of this species comes not as much from its fighting ability as from its quality as a featured item at the dinner table. Liebelt is a fisheries and wildlife biologist working in Fort Peck. Their companion articles begin on page 35.

• **Tom Ganser** characterizes stream inventories as a "Bright Spot in Stream Management." As he explains, the inventory process provides a body of fact on which to base sound management decisions. Plus, it utilizes a team approach involving both state and federal agencies. Ganser is an area biologist for the Soil Conservation Service in Missoula. He is team leader for the inventories of Lake Creek and the Bitterroot, Stillwater, Little Blackfoot and Clark Fork rivers and is responsible for writing those inventories. Turn to his article on page 39.

• Although **Ken Knudson** begins his article with a riddle, there's no mystery about the fundamental "Needs in the Life of a Fish." If water quality, water quantity or habitat needs go unsatisfied in a stream—due to natural or human causes—the fish population will suffer. Human needs and the needs of fish, good water quality for fish equating with good drinking water for people—all are interrelationships and there are mutual benefits to be derived from their common enhancement. Knudson is the pollution control biologist in the Ecological Services Division. His article begins on page 41.■

Alpine Lakes: Fish Among the Clouds

Absaroka Range (photo: Don Aldrich)

by Pat Marcuson

THE DARK surface resounded with the splashing of trout feeding on the summer evening's insect hatch. Heavy clouds swirled up the canyon, intermittently engulfing snow-capped peaks surrounding my evening camp. From the warmth of a pine-litter chair, I reflected on the wealth and beauty of Montana's high country. The next cloud was less charming. It charged in with gusty fury, bolting out spectacular bursts of lightning, deafening thunder and a fusillade of piercing hail. No longer did the trout break water. The lake's surface danced with hailstones as I attempted to burrow deeper into the warmth of my earthy carpet. Then, as rapidly as the storm had blown in, it departed, leaving on the ground a covering of icy pellets and in the air a breeze that drove dampness deeper into the body.

Montana's high country offers immense beauty, impulsive weather and a wonderland of alpine lakes. My backyard looks out on the Beartooth Range, which clutches 948 mountain lakes in a 1,460-square-mile area; and Montana's other 39 mountain ranges cradle hundreds more—in glacial

cirques, alpine valleys and geologic depressions. These lakes vary widely in size (from less than one acre to more than 500 acres), in shape and in depth (from several inches to more than 200 feet). They may be perched anywhere from 4,000 feet to 11,250 feet above sea level. They may nestle within a remote wilderness or on private property.

Whatever their size, locale or unique characteristics, alpine waters are home for a variety of salmonid fishes. Brook and cutthroat trout far exceed the numbers of other species. Lakes with brook trout prevail, because of this fish's availability during former periods of stocking activity, and because of its tenacious capacity for survival. Rainbow, goldens, brown trout, grayling and many hybridized salmonids are also scattered throughout the backcountry.

Aboriginal populations of fish are rare in mountain lakes. (The golden trout, found in California's high Sierras, may be the exception.) Man must take credit, sometimes blame, for the distribution of our finny friends in the mountain lakes in Montana. Few lakes were stocked prior to the 1900s, but during the 1920s our grandfathers, uncles, brothers and dads hauled trout to lakes that had never before harbored a fish. Foresters, trail-builders, prospectors, sheepherders, ranchers—sometimes dentists and druggists—loaded their panniers with fishy cargo and rode to lakes that, so they hoped, might produce fun and food for later visits. Many lakes were stocked with fish by this so-called "creamcan" method. Brook trout were the primary species riding the panniers of this period, and their success is obvious today.

As time progressed new stocking methods evolved, and an era came when fish flew from the clouds, dropped into lakes by airplane and helicopter. The dream of Billings businessmen Dick Logan and Herman Henrickson, as described in a 1939 report of Henrickson's to the Billings Rod and Gun Club, became a reality:

"This being the first time that fish had been planted in this manner at these high altitudes....We were flying at altitudes of 11,000-13,000 feet with nothing but walled canyons, lakes and snow-capped peaks for emergency landings had our motors failed. Tarrant finished his last trip with the Stearman at dusk having traveled about 480 air miles, most over 10,000 feet above sea level, planted 15,000 fish from 2 to 5 inches in length in approximately 4 hours flying time, and into one of the toughest places in the mountains."

The DFWP now drops about 150,000 trout each summer into alpine habitats. The vast majority are cutthroat trout, which have grown to the right size at the right time for surviving in Montana's high lakes. The cutthroat, although not necessarily indigenous to mountain lakes, and the Arctic grayling (which is also periodically stocked) are both native to Montana waters and fitting fish for such scenic environs.

Trout populations in alpine lakes are of two types: 1) *sustaining* populations, where natural reproduction maintains enough fish to replace yearly mortalities, and 2) populations that exist only because they are periodically replenished by stocking. In areas where fishing pressure substantially reduces sustaining populations, it sometimes becomes necessary to augment these too with hatchery-reared trout.

You may have noticed the smallness of brookies in some lakes. Samples of fish and food organisms from "stunted" fisheries usually reveal, as you might expect, high densities of fish and low quantities of food. But a population may be uniformly diminutive for two different reasons. Some supposedly stunted populations are actually limited in longevity, more than in growth rate, and sustain no individuals more than 3 years old; other populations have been identified as truly stunted—old fish suffering malnutrition. One brook trout from Bunny Lake in California's Convict Basin was found, in 1974, to be 24 years old. And this venerable creature was only 9.4 inches long.

Studies in the Beartooths have revealed that many lakes with stunted brook trout are very much like rabbit populations: Excessive reproduction leads to crowding, diminished food and retarded growth. Where fish exist in such large numbers, a natural die-off sometimes occurs, food supplies rebuild and the fish eventually experience renewed growth. Then as conditions improve, reproduction accelerates and the cycle repeats.

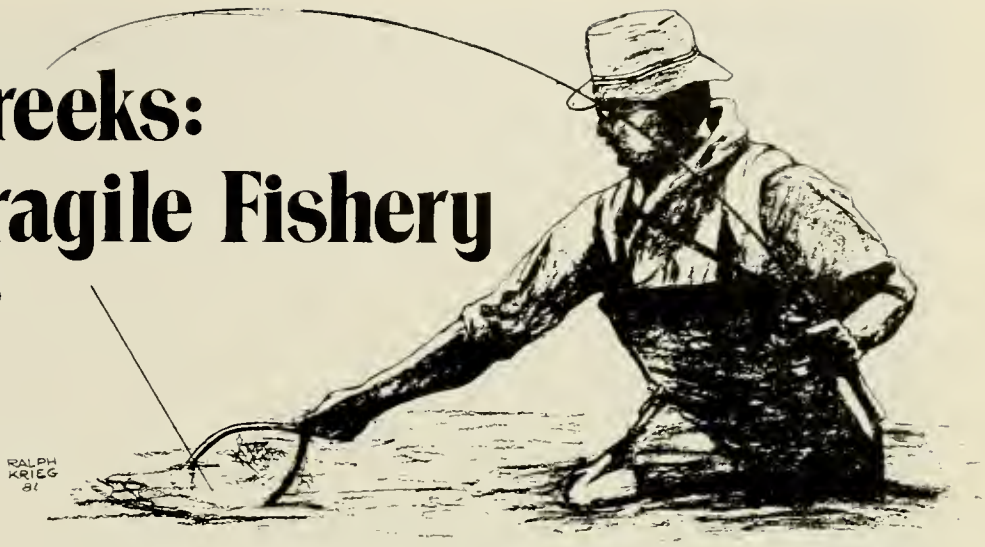
Under hospitable circumstances, individuals of the spring-spawning trout species, rainbow and cutthroat, enjoy six to 10 years of life in alpine lakes. The oldest known fish in Montana's high country were 14-year-old golden trout. Large fish are also available. My experiences with high-country fish have shown me cutthroat trout to 4½ pounds, brook trout to 5½ pounds, grayling and goldens exceeding state and approaching national records. Ongoing studies, geared toward controlling population densities and maintenance of critical food supplies, promise gratifying opportunities for cutthroat trout far superior in size to those in lowland waters.

Many wildlife agencies feel a fish caught every two hours represents a satisfying angling experience—but some alpine lakes yield classy fish to experienced anglers on virtually every cast. To catch 14- to 16-inch cutts in the 1- to 1½ pound range, at a rate of four to five fish per hour, might well be considered excellent fishing; I've seen better in a few well-managed lakes.

Mountain lakes are not exempt from environmental problems. They need a watchful eye and unselfish stewardship to preserve their special characters. Poor logging practices, road construction, mining, overgrazing, acid rains, bad management and overuse by recreationists all pose potential threats—and in some cases have already caused degradation. The number of mountain lakes and downstream waters in Montana far exceed the abilities of the state's 35 aquatic biologists to adequately monitor every water so that it can be managed to its ultimate fish-producing capabilities. But information gathered through alpine investigations will, it is hoped, provide the basis for responsible management of mountain lakes without slighting other aquatic resources. And beyond that, the preservation and good health of Montana alpine lakes will depend upon the conscientiousness of all who journey up to the shores of these mountain gems.■

Spring Creeks: Montana's Fragile Fishery

by Jerry Wells



"And as the fish come to the spring creek through preference, most of them descendants of those that have turned from the broad river, so do the fishermen come to such a shrine, speaking eagerly of those of their kind...."—Charles F. Waterman

WHEN FISHERMEN speak of wild trout fishing in Montana, one most often hears the names of the large rivers. Big, robust and productive rivers like the Madison, the Yellowstone and the Big Hole. Rivers whose very names conjure up, in the minds of fishermen the world over, visions of heavy water, stout rods and large trout.

There is, however, another type of wild trout resource in Montana, a more fragile and delicate resource that one hears less about. Scattered throughout the state—but mostly in the southwestern section—are somewhere in the neighborhood of 100 spring creeks that support wild trout. The source of these spring creeks is ground water that bubbles to the surface. They are typically short, often no more than three miles in length and generally rise in the lush agricultural lands of the river valleys. They can be amazing producers of trout. Their relatively constant flow, their rich water chemistry and the stability of their water temperature (usually between 50-60° F) create an environment where life abounds. Aquatic plants—from algae to watercress—thrive there and provide food for teeming communities of aquatic invertebrates. These invertebrates, in turn, provide ample food for trout. The spring creeks thereby offer unique and valuable fisheries, and are an important part of the fishing resource of Montana.

The extreme clarity of the water and the minuteness of the aquatic insect forms combine to make spring creeks especially challenging to the angler. While all types of angling techniques are used on spring creeks, the most effective tends to be fly-fishing. Spring creek enthusiasts are generally fly-fishermen of many years experience, who are drawn to what many feel is the ultimate test of angling skill. The difficult wading, stout rods and heavy leaders associated with the large rivers must on a spring creek be replaced by stealth, light rods and lighter tippets. It is here that one may observe grown men crawling on their knees, hiding behind trees and cursing silently to themselves as their perfectly presented size #22 mayfly imitation goes unnoticed as it floats through a pod of large trout feeding voraciously on size #22 mayflies. However, the joys and satisfactions experienced on these delicate streams are ample rewards for the frustrations that accompany them. As Charles F. Waterman has said: "Here are the perceptive trouts, the difficult currents, the verdant growths, and the delicate insects that have challenged the studious fisherman for centuries....Many fly-fishermen have given up financial success to live by such streams...."

Spring creeks in Montana vary greatly in both size and notoriety. They range in size from the giant Big Spring Creek near Lewistown, which runs 125 cubic feet of water per second, to numerous and unnamed little jewels that flow less than 10 cfs. Some spring creeks have large fish, some only small. Some spring creeks are famous, others unheard of. Armstrong and Nelson spring creeks on the Yellowstone are nationally known, as is Odell on the Madison. But there are many others, generally smaller, that harbor big trout. They tend to remain somewhat secret—although one may hear them whispered about late at night in certain watering holes of southwestern Montana.

While the spring creeks of Montana can be tremendously productive, they are also terribly fragile. They have in many cases been subjected to environmental degradation, and as a result several have been destroyed. The very factors that account for the tremendous productivity of spring creeks—the constancy of flow and of water temperatures—have in some cases led to their demise. Since their flow pattern is unvarying—without the bankfull, gravel-cleansing spring runoff characteristic of rivers—they are particularly susceptible to sedimentation. Erosion of soil caused by poor land-use practices has caused many spring creeks to fill with sediment, and thus destroyed them. Their constant flow and temperature have also enticed ranchers into converting them to irrigation canals, and entrepreneurs into diverting them for commercial fish hatcheries.

The fact that spring creeks are almost exclusively located on private land has created an access problem for the growing number of spring creek enthusiasts. Ranchers who formerly allowed access to spring creeks may now be faced with as many as 20 fishermen per day at their doorstep, and this pressure has caused some streams to be closed to the public. Many spring creeks are now being purchased or leased by

Spring creeks range in size from the giant Big Spring Creek near Lewistown (DFWP photo: Roger Fliger), which runs 125 cubic feet per second, to numerous little jewels that flow less than 10 cfs.

wealthy anglers for their own exclusive use. Others, such as Armstrong and Nelson on the Yellowstone River, remain open to the public on a limited, fee-paying ($30/day) basis.

With an eye to the future, the Montana Department of Fish, Wildlife and Parks in 1979 purchased the lower two miles of Poindexter Spring Creek (or Poindexter Slough, in the local vernacular) near Dillon. Poindexter is one of the most productive spring creeks in the state and this purchase assures the Montana fisherman access to it forever. Poindexter supports excellent populations of both brown and rainbow trout. It is also important as a spawning stream for trout from the Beaverhead River. This 440-acre parcel of what was formerly the Benson Ranch south of Dillon also includes over a mile of Beaverhead River frontage and three smaller spring creeks. The purchase was made possible by the assistance of the Nature Conservancy (a private organization) and funding from the federal Land and Water Conservation Fund. Upon acquiring the land, the DFWP also received an additional half-mile of the creek upstream from the Benson Ranch from the Montana Department of Highways, which had acquired it as a highway right-of-way in years past.

Spring creeks are an important and unique part of the fishery resource of Montana, and the Montana Department of Fish, Wildlife and Parks is proud to have been able to acquire the Poindexter Fishing Access for the benefit of the people of Montana. The area will be managed so as to maintain and enhance the spring creek wild trout fishery and the other diverse natural values of the site. Access will be on a walk-in basis from a conveniently located parking area. A self-guided walkway, complete with signs describing the uniqueness and fragility of spring creeks, is planned. Trout populations will be monitored annually and appropriate angling regulations recommended to maintain the high-quality fishery that now exists. The Poindexter area is also an important breeding and resting spot for waterfowl, and supports a wide array of nongame birds. It will provide excellent opportunities for waterfowl hunting, bird-watching and leisurely nature walks, as well as the great angling challenge of a crystalline Montana spring creek.

Editor's note *—In January of 1981, in order to maximize the amount of angling recreation without the danger of overharvest, the Fish and Game Commission adopted the following regulation: From December 1 through the opening of the general fishing season (third Saturday in May), Poindexter Slough will be open for catch-and-release fishing using artificial flies and lures. During the general fishing season, regulations for Poindexter will be the same as those for most rivers and streams of southwestern Montana.*■

WARM-WATER FISHERIES

Tongue River (DFWP photo: Kristi DuBois)

Prairie Gold Mine

by Al Elser

TO MOST Montana anglers, the idea of fishing without trout seems akin to peanut butter without jelly or apple pie without ice cream. In a state so well endowed with fantastic trout streams, fishermen rush to the mountains and tend to ignore the prairies. But that's a big mistake, because a wealth of fishing awaits on the plains: in reservoirs, streams and ponds populated with northerns, walleye, sauger, bass and crappie—to name just a few of the species.

While anglers push and shove to get a chance at Montana's blue ribbon streams, the banks of Fort Peck Reservoir, the pools of the Tongue River and a myriad of ranch ponds go almost unnoticed. As a result, these waters offer not only good fishing, but also peace and quiet, with little or no competition from fellow anglers.

Recent discussions among anglers in eastern Montana have centered on the question of enhancing the warm-water fishery in that part of the state, perhaps through hatchery rearing. But one Izaak Waltonian hit the old nail on the head at a sportsmen's meeting in Glendive: "There's an untapped gold mine flowing right past our doorstep," he said, "teeming with pike, cats and hacklebacks just hankering to be caught. And with the price of gas going up, more fishermen are going to have to start tapping rivers such as our Yellowstone." He was right. Rather than expanding our hatchery system to develop more warm-water fisheries, we need to

better direct anglers toward the opportunities awaiting them along the Yellowstone, the Tongue or the Little Missouri rivers. Much work has been done to establish fisheries in warm-water ponds, but the prairie streams represent a virtually untapped resource.

The warm-water streams that meander lazily across Montana's prairies are home to a more diverse community of game and nongame fish than the cold and gin-clear trout streams in western Montana. Over 40 species of fish are known to dwell in the lower Yellowstone, for instance. Among these are nine species of game fish, ranging from the relic paddlefish to the sleek walleye, plus six other species—yellow perch, crappie, bullheads, freshwater drum, rock bass and bluegill—generally considered to be of sporting quality.

Although the usual angling technique for most of these fish is nothing more than still-fishing—drifting a worm or minnow at the foot of a riffle or the mouth of a backwater—that is more a matter of tradition than of necessity. Sauger, walleye, northern pike, goldeye and even channel cats will smack any lure that resembles a minnow. Setlines, offering an angler up to six opportunities to catch a fish, are also legal.

A unique angling opportunity for those who are strong of spirit, soul and body develops in late February and early March. That's when "the brotherhood of ling fishers" gathers in early evening at favorite spots along the Yellowstone. Fellowship abounds as tales are swapped about the giants that got away. While the burbot, known locally as the ling, would probably place dead last in a beauty contest, this odd fish can provide some hot action on a cold river bank.

The ling is the only freshwater member of the codfish family. It is distinguished from other Montana fish by its eel-like appearance and the single barbel, or "whisker," under its chin. Spawning and feeding migrations occur during the winter, with fish moving upstream, congregating in deep holes below diversion dams and in the mouths of small tributary streams. Cold winter weather, coupled with the ling's habit of increased feeding activity late at night, offer a wild fishing opportunity. Ling are predatory fish, so a hook baited with a lively minow has an excellent chance of ending up in a ling's lip.

As winter's harshness wanes and the softness of spring spreads across the prairie, another exciting fishery develops. Smallmouth bass, reacting to their ageless urge to spawn, bunch up at the mouth of Hanging Woman Creek, a small feeder flowing into the Tongue River at Birney. The Tongue in this area is characterized by wide bends that meander around giant cottonwoods, and by bubbling riffles and deep pools. Scrappy smallmouth are available throughout.

Smallmouth bass are not native to the Tongue River, but were stocked in the late 1960s, and remain today in a healthy, fishable population. A three-pounder rates as a good fish, and bass as large as that will often go for a curly-tailed plastic worm retrieved through one of the river's numerous holes. It has been said that happiness is a smallmouth bass taken on a fly rod. Ounce for ounce this fish is probably the most dramatic fighter around.

Certain other monsters lurk at the mouth of Hanging Woman Creek, awaiting an angler's offering. Besides bullheads, perch, crappie and rock bass (a species unique to the Tongue River), northern pike up to 12 pounds have been caught here.

Without a doubt, the most overlooked fishery in the lower Yellowstone is the run of walleye that appears each spring downstream from Intake. Walleye are not native to Montana and the Intake fishery is composed of migrants from North Dakota. Primarily inhabiting large lakes and reservoirs (see Jim Liebelt's article, "The Walleye of Fort Peck Reservoir," p. 37), walleye move into tributary rivers to spawn. North Dakota introduced walleye into Lake Sakakawea (the first mainstem Missouri River Reservoir downstream from the mouth of the Yellowstone), where they have become that lake's premier game fish. Now as the ice goes off the Missouri, walleye concentrate in the upper end of Lake Sakakawea, then ascend the Yellowstone to reproduce. Immediately downstream from the Intake diversion dam, the fish concentrate, providing an excellent fishery.

Department biologists have monitored this population since 1974. It is estimated that, at the peak of their run, nearly 1,600 walleye are found per mile of river. This represents nearly one ton of fish flesh. And tag returns by anglers suggest that less than 3% of these fish are caught on hook and line.

While walleye in lakes are often frustrating since they are difficult to locate and, when found, to entice into striking—once they hit that river, it's a different story. Males defend their territories, appetites pick up when spawning is completed and the walleye are vulnerable to sport fishermen. Successful fishing gear ranges from live minnows to spoons to feathered jigs.

Super fishing for shovelnose sturgeon (a.k.a. "hacklebacks") abounds throughout the lower Yellowstone. Just as sure as swallows return to Capistrano, hacklebacks return to their traditional spawning grounds in the Tongue and Powder rivers.

The prime hackleback fishing occurs in the spring when the fish move to spawning areas and bite readily. The most numerous catches and the largest fish are usually taken in May, June or July, when the prairie streams are swollen with spring runoff. A big gob of night crawler, fished right on the bottom in areas of moderate current, usually brings the best results. Although generally neglected by anglers, shovelnose sturgeon provide excellent table fare.

The bread-and-butter fishery of our warm-water streams is old "Mr. Whiskers," the channel catfish. Distributed throughout eastern Montana in all the large rivers and many of the small prairie piddlers, this unique fish may not be comely, but it has a special place in the hearts of many anglers. When hooked, the channel catfish bulldogs, rolls over the bottom and makes powerful runs. An insatiable appetite helps make it a popular sport fish—and a whole book could be devoted to baits. In fact, the mystique surrounding catfish baits is as elaborate, and the diversity of

types as great, as those of artificial flies used for trout. Some common offerings, tempting to any catfish's palate, are live bait (worms, minnows, frogs), cut bait (chunks of fish), soft bait (beef liver, thick chicken blood) and stink bait (soured venison, rotten minnows, spoiled liver, Limburger cheese). Stink bait recipes are often more treasured than the recipe for granddad's dandelion wine. Artificial lures also take their share of cats.

Channel catfish usually feed most actively early in the morning or late in the day. Fishing is generally better in early spring and late summer. Angling hot spots for the whiskered cat include deep holes and areas where the current rolls around brush, rock piles, boulders and bridge abutments, or where it cuts under fallen trees and overhanging brush. Channel cats like to hide all day in such cover, and if you place an attractive bait in front of them, chances are they'll grab it. While this old stand-by is considered a game fish in Montana, no daily or possession limit exists.

Fishing the prairie streams of eastern Montana is akin to playing roulette in Las Vegas: With the number of angling opportunities available, you never know what you might pull in. Our warm-water streams guarantee a quality and variety of fishing available in few other places in the United States. Whether you go after ling, smallmouth or hacklebacks, once you have fished the plains that rise to meet the Rockies, you'll ask why they have been neglected by anglers for so long.■

The Walleye of Fort Peck Reservoir

by James E. Liebelt

ASK ALMOST any fisherman in northeastern Montana what his favorite fish is and the vast majority will answer: "walleye!" The popularity of this species stems not as much from its fighting ability as from the fact it offers about the finest eating around. Wherever and whenever the walleye are biting, you can be sure that a crowd of fishermen will soon be there—and this is particularly true in the Big Dry Arm of Fort Peck Reservoir.

According to DFWP stocking records, walleye were first introduced into Fort Peck Reservoir—in the form of 878,000 walleye fry—during May and June of 1951. These walleye apparently found things to their liking, and the species established itself throughout the reservoir, but became particularly abundant in the Big Dry Arm.

While some walleye were caught during the late 1950s and throughout the 1960s, not until the 1970s did things really begin to erupt. As late as 1974, walleye fishermen were few and far between in the Big Dry Arm during April and May, but in the years immediately thereafter fishing pressure increased dramatically.

My own professional experience with walleye began in 1974, when I was able to capture and tag almost 1,400 during April and early May—primarily in the Nelson Creek area of the Big Dry Arm. It was apparent that these fish were moving toward the head of the Dry Arm for spawning. Each spring since that time walleye have been trapped and tagged in this area, and the total number that have been marked is over 7,000.

In succeeding years recapture of tagged walleye by trapping and netting, plus tags returned by fishermen, have provided information regarding the harvest and movement of these fish. For example, over 90% of the tagged walleye taken by fishermen were caught in the Big Dry Arm. This indicates clearly that the majority of walleye tagged during the spring spawning run tend to remain in this arm of the reservoir throughout much, if not all, of their lives. A few tagged walleye have been caught in other areas of the main reservoir; several have even been caught in the Missouri River Dredge Cut complex below Fort Peck Dam. These fish no doubt left the reservoir through the spillway, which was opened during the high-water years of 1975 and 1976.

The return of tags by fishermen has also provided information regarding the levels of the walleye harvest. These estimates reflect minimum harvest levels, because they are based on number of tags *returned* to the DFWP—not numbers of harvested fish for which tags are for some reason unreturned. The average cumulative harvest from 1974 through 1979, judged on this basis, amounts to about 18% of the total walleye tagged. This indicates that a significant segment of the Big Dry Arm walleye population has ended up in people's frying pans. The highest return for any one year occurred in 1978, when almost 21% of the total (1,564) fish tagged that year were caught; the lowest return was 5.5% of the total group (1,912) tagged in 1976. In 1978 an intensive effort was made to retrieve tags by conducting a creel census in the Nelson Creek/McGuire Creek areas during the spring and by installing tag-return boxes furnished with mailing envelopes along major roads to the Big Dry Arm. These measures accounted in part for the relatively high tag return that year.

Another important phase of work relative to the walleye in Fort Peck Reservoir has been the sampling for various larval (newly hatched) stages of this species. These small fish,

Walleye reproduction is often inadequate at Fort Peck Reservoir. A fisheries researcher (left) is taking spawn for supplemental planting. Since 1974, over 7,000 walleye have been captured and tagged (below) in the Nelson Creek area of the Big Dry Arm (DFWP photos: Mike Aderhold).

about 7 millimeters long upon hatching during May, are captured with special nets staked in a stream or towed by boat near the surface of the water.

Sampling first began in May of 1977, and findings indicated poor walleye reproduction that year: Only two larval walleye were captured the entire spring. It was a very dry season, and almost no spring runoff occurred. During the spring of 1978, and again in 1979, two years when good runoff occurred, substantial numbers of larval walleye were captured. Although these fish were found primarily near the head of Big Dry Arm, it became obvious from sampling Big Dry Creek in 1979 that the adult walleye had migrated up the creek to spawn, and that the newly hatched walleye were drifting downstream into the reservoir. This discovery provides evidence that the walleye populations in the Big Dry Arm are dependent upon adequate spring flows in Big Dry Creek for successful reproduction. Big Dry Creek is characterized by an abundance of gravel riffles, which are used for spawning, and by pools below the riffles, where the adults can find shelter before and during the spawning period. But access to the riffles is a major problem, particularly if the reservoir is low or if spring flows are not adequate to allow upstream fish migration. Low flows occurred again in the spring of 1980, resulting in poor walleye reproduction.

In order to further augment the walleye fishery, and also to compensate for years of poor reproduction, the DFWP has in the past few years planted about 840,000 fry (1- to 2-inch fish) in Fort Peck Reservoir. Although the mortality rate for these small fish is usually quite high due to predation and other factors, some will survive to eventually enter the fishery, and to provide additional stock for natural reproduction. While many fishermen believe that stocking is the answer to better walleye fishing, we stress that natural reproduction is the key to good walleye fishing, particularly in a huge reservoir like Fort Peck. Stocked walleye fry are a poor substitute for the millions that can be produced by a wild population when the right conditions occur.

What other problems face this fishery in the future? Just over the horizon looms the prospect of development of the vast coal reserves that lie buried only a few miles from the Big Dry Arm. A large industrial complex designed to use this coal for production of ammonia sulfate fertilizer, methanol and synthetic diesel fuels—the synfuels we have begun hearing so much about—may be constructed in the area. A sizable amount of water would be required to produce these substances, and plans now call for pumping this water through a large pipeline from the Big Dry Arm to the plant site. What effects such industrial activity will eventually have on the fisheries of Fort Peck Reservoir can only be guessed at today. Certainly the population of this area will increase, and with that increase will come added use and fishing pressure; the withdrawal of large volumes of water may also create problems for the fishery.

Department personnel will continue to monitor the fisheries in Fort Peck Reservoir, and try to provide at least some of the solutions to problems as they arise. Our goal is to maintain adequate walleye fishing through a sound management program.■

Bright Spot in Stream Management

by Tom Ganser

MONTANA'S streams and the lands adjacent to those streams are very special resource areas. These streams and their corridors harbor an abundance of small and large wildlife, support fisheries and border some of the richest agricultural land in the state. It's another world, a world that requires a different set of land management techniques and practices. And to be effective these techniques and practices

Stream inventorying in Montana includes studies on the Bitterroot (top photo: George Wuerthner). This slump (photo: Soil Conservation Service) on the Stillwater River narrowed the river channel from 80 feet to less than 10 feet, which increased stream velocity, erosion and turbidity.

must consider the entire stream. A stream bank alteration on one bend can be felt miles downstream.

Until recently, few resource inventories existed for Montana streams and rivers, and the existing ones varied in detail and scope. Now, at the request of the state's conservation districts, several conservation agencies are systematically collecting a comprehensive body of information.

Such information can be helpful to landowners, land users and professional resource managers. "The stream inventory gives us the ability to look at the whole picture," explains Robin Street, past chairman of the Flathead Conservation District. "It makes people realize the problems and encourages them to move ahead to solve them." Don Peters, fisheries biologist for the Department of Fish, Wildlife and Parks in Missoula, says of his experience on the Bitterroot River inventory: "I was impressed. I learned a tremendous amount about the river. It really assists us in relating our very detailed studies on small sections to the needs of the entire river."

Seven inventories have been completed in Montana, namely those for the Whitefish, Ruby, Bitterroot, Stillwater, Little Blackfoot and lower Big Hole rivers, as well as Rock Creek in Carbon County. The Beaverhead River and Lake Creek inventories will be published in 1981. Field work for the Clark Fork of the Columbia and the Clark's Fork of the Yellowstone is planned for this summer.

The inventory procedure was developed by Norm Peterson of the DFWP and later refined by Ron Batchelor and myself, both of us biologists with the U.S. Soil Conservation Service (SCS). The inventories have been conducted by a team representing the SCS, DFWP and, in some cases, the U.S. Fish and Wildlife Service and the Water Quality Bureau of the Montana Department of Health and Environmental Sciences.

The year-long process begins with the inventory team walking or floating stretches of the river. Depending on the stream and the recognized problems, the team notes the following on aerial photographs of the stream corridor: stream bank alterations, channel alterations, eroding banks, critical sediment sources, stream bank vegetation, type of streambed material, pools, riffles, obstructions and debris.

Stream bank alterations, which include things such as rock riprap and jetties, are designated with a measurement in feet along the bank. This measurement gives the team an idea how much work has already been done to stabilize the stream bank. Channel alterations are identified, to determine the cause of any particular stream straightening, and the effects that straightening may have on other sections of the stream.

Eroding banks and critical sediment sources are also identified, to determine the effects of man's activities and to assist in planning the method of treatment. Stream bank vegetation or lack of it is noted, to document loss of riparian habitat (the natural band of vegetation along a stream) and as an indicator of the pressure being placed on the river by human activity.

The character of streambed material (sand and silt, gravel, rubble and boulders) is recorded. This information, as well as the arrangement of pools and riffles, is important in determining the potential quality of the stream as a fishery. It also tells us something about the effects of sediments added to the stream system. Obstructions (relevant to river floaters) are noted, and debris or trash is identified so that it may later be removed.

After these data have been drawn onto the aerial photographs, the team meets again to look at the data and discuss the implications. Often the team decides not to finalize portions of the report until specialists have been consulted about some specific problems. For example, the Stillwater River team was uncertain what caused massive bank slumps on that river. While some team members suspected that irrigation had aggravated the slumps, others believed the slumps might be an entirely natural occurrence. Convincing evidence is available to support either idea. To settle the question, the team asked engineers, a geologist and Flathead Conservation District supervisors to examine the problem and to help finalize this section of the report.

In the last section of each report, the team lists recommendations for managing the stream corridor. Robin Street says: "These inventories give us a place from which to start. We may not always agree with the recommendations, but they give us a chance to start talking. These reports would be useless if the team did not give an honest assessment of what is occurring and how to correct it."

Landowners adjacent to a stream can bring invaluable knowledge and experience to an inventory. Those landowners are also the ones who must accept and apply the recommendations if improved management of the stream corridor is to become a reality. For these reasons, on our more recent inventories (those of the Stillwater and Little Blackfoot rivers) we met with individuals owning adjacent lands. The meetings were sponsored by local conservation districts, and attendance was excellent. The purpose was to discuss the data we had accumulated from our field work, the meaning of those data, and—before the report was finalized—potential solutions to the problems that had been identified.

Once the report is completed, the job really begins. To be successful, the report must assist in generating better management of the stream corridor. The Flathead Conservation District is using the Stillwater River report in cross-reference with a water quality nutrient study which the district has initiated on the Stillwater. The district hopes to correlate water quality problems with land resource needs.

The Ravalli Conservation District is using the Bitterroot River report in formulating the district's long-range plan.

The report on the Little Blackfoot River is being used to seek funding for necessary treatment measures.

Stream inventories give resource managers the opportunity to work cooperatively with landowners in taking care of their resources. This not only helps landowners to protect and use valuable land properly, but it also helps to preserve other important attributes of the river system—water quality, and fish and wildlife habitat.

The future is bright for stream inventories. They are giving us a body of facts on which to base sound management decisions. Their acceptance by local and state government points to a new era in stream corridor management in Montana.■

Needs in the Life of a Fish

by Ken Knudson

Question: What do

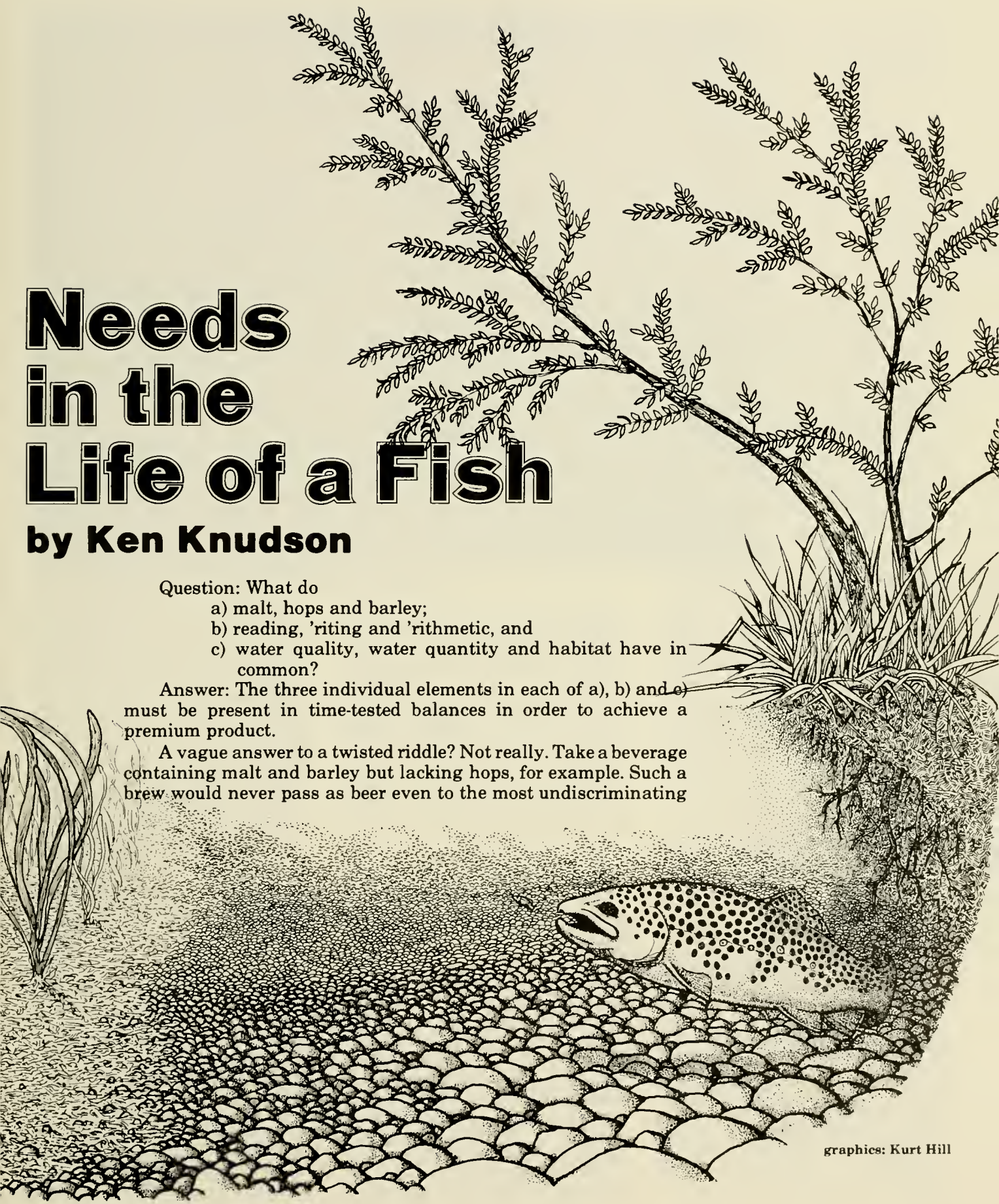
a) malt, hops and barley;

b) reading, 'riting and 'rithmetic, and

c) water quality, water quantity and habitat have in common?

Answer: The three individual elements in each of a), b) and c) must be present in time-tested balances in order to achieve a premium product.

A vague answer to a twisted riddle? Not really. Take a beverage containing malt and barley but lacking hops, for example. Such a brew would never pass as beer even to the most undiscriminating



graphics: Kurt Hill

When streamside trees and plants are left intact, both humans and fish benefit. Overhanging willows and their underwater root masses provide excellent habitat for "bragging-sized" brown trout on the Clark Fork River above Deer Lodge. The intertwining roots also stabilize the stream banks, preventing erosion and flooding (DFWP photo: Bill Schneider).

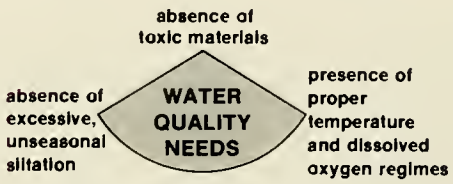
keg-tapper. Likewise, a student who may be brilliant in math but poorly trained in verbal skills would be slow to impress anyone. And so, too, it is with a fine fishing hole: You would be hard pressed to find any spot on any stream that consistently produces good catches of fish, if that spot isn't blessed with a proper blend of good *water quality,* adequate *water quantity,* and suitable *habitat.* Let's examine the individual components of these three essential needs in the life of a fish.

WATER QUALITY

When sunlight warms the earth's surface, causing evaporation, even the most foul body of water yields pure, clean water vapor to the clouds. But as soon as water returns to the earth's surface as precipitation, it begins dissolving the salts of numerous chemical compounds. Many of these dissolved materials are essential as basic food sources for such aquatic organisms as microscopic algae. And the algae are primary food sources for larger organisms—like aquatic insects—which are in turn important sources of fish food.

The quality of water is therefore a function of numerous water-soluble materials, some of which are beneficial to aquatic food chains; others (chiefly those introduced by certain human activities) are harmful. When human activities create measurable concentrations of unwanted materials within a body of water, the stream or lake is described as polluted.

What are the fundamental water quality requirements of fish? They generally fall into three categories:


absence of toxic materials
absence of excessive, unseasonal siltation
WATER QUALITY NEEDS
presence of proper temperature and dissolved oxygen regimes

Toxic materials—The sources and types of materials toxic to fish and other animals are numerous and widespread. Industrial factories and processing plants have historically been the most noticeable sources of water pollution, but discharges from cities and farms can also introduce herbicides, pesticides and related materials into water. A list of materials potentially poisonous to fish would easily fill all of the pages of this magazine. The most prevalent types of toxic substances, however, are 1) pesticides and similar man-made compounds and 2) the "heavy" metal groups of elements, including mercury, arsenic, zinc, lead and copper. Pesticides normally enter waterways through diffuse ("non-point") sources, such as runoff from cities or farms; heavy metals commonly originate from localized ("point") discharges, such as those from mines or industrial plants.

Toxic materials harm fish as they would humans, i.e., obstructing vital organs and causing the collapse of breathing, blood circulation or nervous functions. Fish are usually more susceptible to poisonous materials than are land-dwelling creatures—fish must be constantly surrounded by water and this inhibits their ability to avoid harmful, introduced substances. Therefore, when evaluating the potability of a body of water, a standard rule is: If a healthy fish population is present in the stream, it is probably an excellent source of drinking water. (The water, of course, should not be drunk without disinfecting to remove organisms that could cause disease in humans.)

Temperature and dissolved

In Montana, dewatering is a much more significant cause of losses to fish populations than is water pollution. The Jefferson River at Silver Star is shown both during a normal and a dry year. Unless provisions are made to reserve a minimum instream flow, "dewatered" streams will become more common in the state (photos: Joe M. Halterman).

oxygen—Fish can survive only within a very narrow range of water temperatures. Trout, for example, thrive best at water temperatures from 40° to 60°F. When temperatures exceed 65°F, growth is impaired; death may occur when water temperatures exceed 75°F. Excessively high temperatures are commonly caused by either 1) dams or irrigation return flows, which reduce stream flow rates and increase water-surface-to-volume ratios, 2) removal of streamside vegetation or 3) the discharge of industrial cooling water.

The amount of oxygen dissolved in the water is also critical for fish populations. Even under optimal conditions, only about one ounce of oxygen can be dissolved in 1,000 gallons of water; this is equivalent to only about one-fortieth of the amount of oxygen available to air-breathing organisms like you and me. But fish (and some other aquatic organisms) have evolved intricate, featherlike gill structures that extract this very limited amount of oxygen from water.

Certain industrial and all municipal (sewage) discharges introduce so-called "oxygen-demanding" materials that directly remove oxygen from the water. The nighttime growing phase of aquatic plants like algae (commonly called *moss*) also removes oxygen from the water. Excessive growths of algae or other plants can seriously deplete a stream's oxygen content; these unwanted accumulations of aquatic plants are stimulated by the discharge of fertilizers (synthetic and natural) from irrigated farmlands, feedlots, septic tank drain fields and sewage treatment plants.

Siltation—Muddy water is a seasonal occurrence for fish, even in the most pristine mountain watersheds. In most streams, however, high concentrations of silt normally are present only during spring runoff. Through the process of natural selection, spanning millions of years, fish and other aquatic life have adjusted their spawning and egg-incubation periods to avoid the annual surges of silty water.

If abnormally high amounts of silt are introduced to a stream during other times of the year—from construction activities, for instance, or improperly logged timber sales, or storm drains, or poorly managed farms—the turbid water may suffocate developing eggs or immature fish. And if such unseasonal siltation is highly concentrated, abrasion of gill surfaces, even suffocation, may also cause mortality to adult fish.

WATER QUANTITY

Water quantity refers to the quantitative measurement of water within a stream. Nearly any streamside development—industrial, agricultural or residential—will bring concomitant competition with fish and other aquatic life for surface water.

Every stream in our state (with the possible exception of those originating and terminating wholly within public lands) experiences some degree of reduction from its historical (that is, before human development) flows. Many streams or sections of streams are often severely "dewatered" during summer: Notable examples include the West Gallatin, Big Hole, Dearborn, Boulder, Jefferson, Shields, upper Clark Fork, Bitterroot and Musselshell rivers. As well, numerous smaller tributary streams often suffer *total* dewatering.

A certain minimal volume of water is necessary in any stream to provide adequate living space, and increased competition among fish due to overcrowding is the most obvious water quantity-related problem within a dewatered stream. But adequate quantities of water are necessary also to satisfy other important needs of fish:

Dilution—As a stream experiences increased water withdrawals, it also loses its capacity to dilute wastes; water quantity is therefore tied closely to water quality. Although few believe that "dilution is the solution to pollution," the fact remains that if the amount of waste entering a stream remains constant—while reductions occur in the total stream volume—actual instream concentrations of harmful substances will increase. The Environmental Protection Agency and the Montana Department of Health

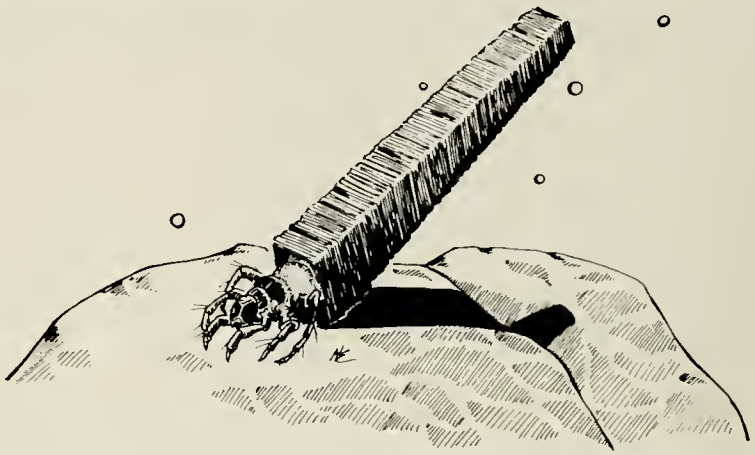
and Environmental Sciences have both targeted water quantity as one of the most significant factors to be considered in the struggle to maintain and enhance the water quality of streams during the coming years.

Flow over shallow areas—Most of Montana's fish species spawn in shallow, fast-flowing riffle areas. These sites are also important habitat for the nymphal (immature) stages of stoneflies, caddisflies, mayflies and other organisms important as food for fish. When water is withdrawn from the stream channel, these shallow zones of passage between pools are the first areas drastically affected. Broad riffles that once spanned the total width of a stream may be reduced to a trickle. Eggs deposited by spawning fish during normal stream discharges are left high and dry. Since each fish species only spawns once a year, substantial portions of entire age classes of fish may be eliminated—not to mention aquatic insects by the millions.

Dominant discharge—In northern states like Montana, at least one annual surge of high water occurs during early summer, in response to mountain snowmelt. This rapid runoff (or "dominant discharge") produces high-velocity, bank-full conditions that flush stream channels clean of the past year's accumulation of silt and debris. Bank-full flows—particularly when the high water begins to clear following peak runoff—cleanse bottom gravels, leaving them suitable for spawning and insect habitation. These flows also purge debris from important areas of habitat, like undercut banks. But fish and humans compete for the benefits of dominant discharges when 1) irrigation demands are heavy during the runoff period and 2) hydroelectric or irrigation impoundments capture peak stream discharges for later release.

HABITAT

The habitat of an organism is the place where it lives. Every animal on the planet, from human to lowly flea, has special habitat requirements, its own special niche in the architecture of life's interactions. For underwater organisms like fish, good habitat usually amounts to good overhead cover. A stream without a canopy of trees and plants along its banks—at resting areas, food-gathering sites and spawning beds—is like the floor of a house without walls or roof: less than ideal for permanent habitation.



The caddisfly nymph (above) is depicted within its protective case. The stonefly (opposite) is a predator which seeks other smaller aquatic insects. Montana's famous "salmonfly" hatches are actually mature, flying stages of the state's largest stonefly species. Both of these insect families are often more sensitive to pollutants than are trout (graphics: Harvey Eckert).

Every natural watercourse has carved its stream channel in response to the physical lay of the land. Water runs downhill, but rarely in a straight line. Differences in soil types, gradient, natural barriers (i.e., logs, boulders and tree roots) and vegetation cause natural stream channels to meander and braid, following the path of least resistance.

These seemingly haphazard wanderings create protected places for fish. Let's examine the most important aspects of fish habitat:

Riparian vegetation—This term refers to those plants and trees growing along the banks of a natural watercourse. These are primarily water-loving plants, including willows, birch, sedges, aspen, rushes and cottonwoods. When the lush growth of riparian plants is left intact along the banks of a stream, vital overhead cover is provided for fish.

On smaller streams this overhead canopy also performs another important function: shading the stream from the sun's intense heat. Removal of bank cover can cause daytime water temperatures to increase by as much as 10°F, which in certain summer situations is significant enough to cause problems for cold-water fish like trout.

Undercut banks—For fish, the roots of riparian plants are as beneficial as the more obvious stems and leaves. The force of flowing water is directed into stream banks at every bend and meander. If riparian vegetation has not been removed from these areas, the banks are stabilized by the intertwining root masses, and very little erosion occurs above the water level. Instead, the water undercuts the bank beneath the vegetation, forming ledges of protective cover.

Midchannel cover—The larger the stream, the greater the need for cover other than that provided along the banks. Midchannel habitat is provided chiefly by boulders and logs. As water swirls around these objects, part of its force is directed downward, causing localized scouring of the stream bottom. Fish congregate in the quiet water near the bottom of these pools, where they are protected from overhead view by the eddying agitation of the surface water as it flows around the obstructions.

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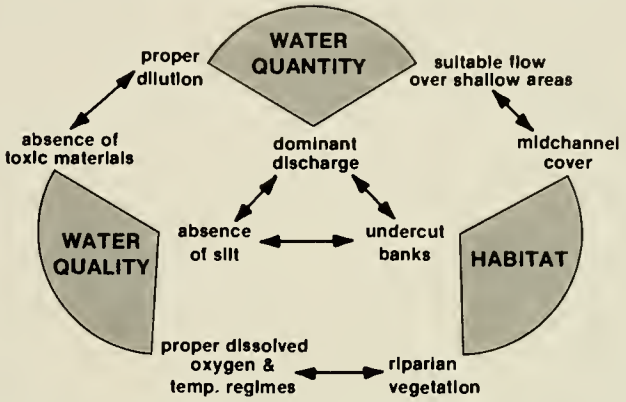
These are the fundamental needs in the life of a fish. If *any one of them* goes unsatisfied in a stream, due to natural or human causes, the fish population will be harmed.

Several times each year, I receive

calls from concerned anglers stating that there seem to be few (if any) fish at a site where they had recently tried their luck. The culprit most commonly suspected by these callers is pollution. "Anything been dumped into that creek lately?" they often ask. Their suspicion is understandable. Clean-water campaigns have been actively attacking water pollution for decades. However, much less publicity has been generated about the problems that fish populations face when *water quantity* and *habitat* are adversely affected by man.

This oversight is unfortunate, because in Montana and other western states the loss of good overhead cover and/or dewatering probably account for over 90% of the human-caused detriment to fish populations. And whereas millions of dollars of private, state and federal funds are spent every year in Montana to clean up pollution, the effort to cope with habitat loss and insufficient stream flow regimes is only just beginning.

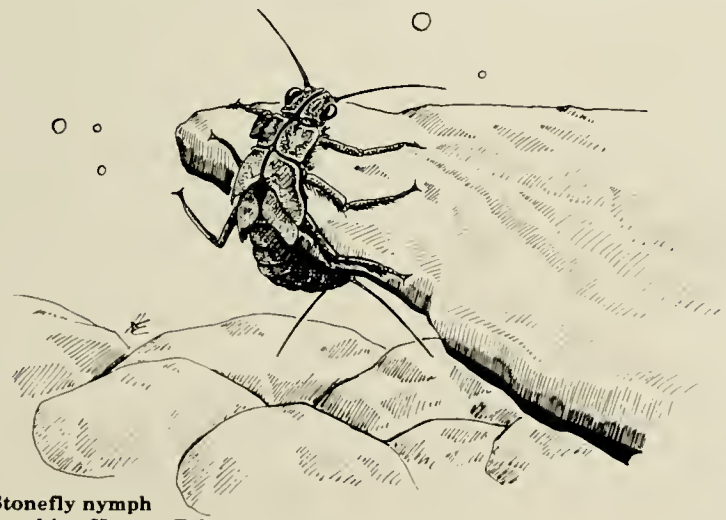
Another oversight is this: Too often we may be looking for *the* culprit, when in fact a damaged fish population is more likely suffering from several lesser problems in combination. The interdependence of fish needs has already been noted, but to repeat: Adequate water quantity relates to dilution of toxic materials; riparian vegetation relates to water temperatures in summer; bank-full discharges during runoff relate to cleansing away of silt, which in turn relates to adequate habitat for insects and good conditions for hatching of fish eggs, etc. If all of the aforementioned needs are combined into one diagram, their interrelationships perhaps become more clear:



It should be apparent that, because of this interconnectedness, isolating a particular problem that may be affecting a fish population is often not a simple task. But there is a bright side: By making improvements in one problem area, you are likely also to effect benefits in at least one other.

For example, consider a stream with an irrigation dam that captures nearly all of the peak stream flows. If provisions are made to release a dominant discharge from this dam, not only will the stream gravels be cleansed of silt, but undercut bank habitat will also be improved. This flushing will also help maintain stream channel integrity by removing excessive accumulations of sand and debris; if fine bottom material were not removed, more of the stream's water force would be directed into the stream banks, causing the eventual destruction of riparian vegetation. Such channel movement would therefore not only be detrimental to fish habitat, but would also affect the property of adjacent landowners, due to the increased potential for erosion and flooding.

The above example of the interrelationships of human needs to those of fish, along with good water quality for fish equating to good drinking water for people, are mutual benefits that often go unrecognized. And while the primary role of the Department of Fish, Wildlife and Parks is to manage fish and wildlife, we believe, within the context of our water resources protection programs, that what is good for fish is also good for the people of our state. Human needs are certainly more complex than those of fish; yet where the two meet or overlap, there are nearly always mutual benefits to be derived from their common enhancement. We of the DFWP fervently hope that recognition of these correlating benefits will be an important theme of the 1980s.■



Stonefly nymph
graphics: Harvey Eckert

Cover and space in a nontoxic place
are needs in the life of a fish.
Overhead ledges of willow and sedges
are needs in the life of a fish.

Spawning sites for moonlit nights
with gravels free of silt and debris;
Tasty bugs on mossy rugs
are needs in the life of a fish.

Cool, clear pools like emerald jewels
are soaring in value
which prompts me to tell you
that human direction toward instream protection
are needs in the life of a fish.

—Ken Knudson

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